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Errata

p. 82, l. 20: for REIMAROCHOLA read REIMAROCHLOA.
p. 88, l. 23: for MERETENSII read MERTENSII.
p. 91, l. 5: for PARVIFOLIA read PARVIFOLIUS.
p. 148, l. 18: for *Taxosium* read *Taxodium*.
p. 173, l. 8 from bottom: for of read or.
p. 173, l. 7 from bottom: for shouly read should.
p. 210, l. 22: for CALATHERA read CALATHEA.
p. 223, l. 5: for SURINAMS read SURINAM:
p. 233, l. 11 from bottom: for *nematoides* read *nematodes*.
p. 234, l. 5: for *Waldsteinea* read *Waldsteinia*.
p. 234, l. 8: for *goldianum* read *goldieanum*.
p. 235. The running head should read TORREYA.
p. 268, l. 26, 28: for CALAMOGROSTIS read CALAMAGROSTIS.
p. 269, l. 15 from bottom: for OXYCANTHOIDES read OXYACANTHOIDES.
p. 281, l. 12 from bottom: for THOMASH read THOMASII.
p. 299, l. 4 from bottom: for SESSIFOLIA read SESSILIFOLIA.
p. 371, l. 7: for *Eulophea* read *Eulophia*.
p. 384, l. 20 from bottom: for CINNAMONEA read CINNAMOMEA.
p. 408, l. 7: for *Eurphorbia* read *Euphorbia*.
p. 408, l. 16: for OCCIDENTATE read OCCIDENTALE.
p. 414, l. 3 from bottom and p. 415, l. 2: for *guianensis* read *guianense*.
p. 437, l. 17 from bottom: for *A*. read *R*.
p. 446, l. 16: change 1903 to 1907.
p. 446. l. 20, 21: the two lines referring to Jelliffe should de deleted.
p. 513, l. 12 from bottom and p. 515, l. 3: for *Jaegerii* read *Jaegeri*.
p. 517, l. 4 from bottom: for *Boyce-Thomsonii* read *Boyce-Thompsoni*.
p. 520, l. 1: for *mamillata* read *mammillata*.
p. 520, l. 14 from bottom: *pollen* should be in roman type.
p. 527, l. 15, 18: for C. and *C*. read R. and *R*.
p. 555, l. 12 from bottom: for MANDIVILLA read MANDEVILLA.
p. 569, l. 7: for GLABRASCENS read GLABRESCENS.
p. 595, l. 9 from bottom: for tri-idobenzoic read tri-iodobenzoic.

BULLETIN OF THE TORREY BOTANICAL CLUB
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FLUORESCING SUBSTANCES IN ROOTS

RICHARD H. GOODWIN AND FREDERICK KAVANAGH[1]

Blue and yellow fluorescing materials have been previously reported from the roots of legumes (Linsbauer 1929). In the course of an investigation of the inhibition of the first internode of *Avena sativa* by light (Goodwin 1941) it was observed that a bright blue fluorescence was excited in the roots of the experimental plants by ultra-violet light (the 3650 Å line from a 100-watt G. E. type H4 mercury arc lamp screened with Corning Nos. 5860 and 738 glass filters).

The nature of the fluorescent material has been investigated. Preliminary studies in 1942 showed that it could be extracted from *Avena* roots with n-butanol. The material in the extract could not be identified with pure thiochrome; first, because of its slower photodecomposition in ultra-violet light, and second, because its fluorescent spectrum showed a higher intensity in the blue-green than that of thiochrome.[2]

In the present paper the authors wish, first, to record some observations on the occurrence of fluorescing substances in the roots of different species of plants, and second, to report some of the properties of these substances, which have been extracted from the roots of several species, but particularly from *Avena.*

The Occurrence of Fluorescing Substances in the Roots of Plants. In order to ascertain the occurrence of fluorescing compounds in the roots of higher plants, the roots of 135 species belonging to 126 genera and 69 families were examined in ultra-violet light from an AH–4 Mazda mercury arc lamp shielded with a Corning No. 5860 glass filter. For each species a subjective judgment was made of the color and intensity of the fluorescence. The results of this survey are recorded in table 1.

The roots of all but six species examined were definitely fluorescent. The exceptions were ferns with blackish pigment in the roots; but acetone extracts of the roots of three of these species and the rhizomes of two others were brightly fluorescent. The most common color of the fluorescence was

[1] The cost of publishing table 1 has been partly defrayed by a grant from Connecticut College.

[2] The fluorescent spectra of quinine, thiochrome, and the fluorescent material from *Avena* roots were photographed with a Bausch and Lomb quartz spectrograph. The densities of the plates were then determined on a recording photo-electric densitometer. The authors are indebted to Dr. L. T. Steadman of the Division of Radiology, School of Medicine and Dentistry, the University of Rochester, for use of the spectrograph, and to Dr. Fred Perrin of Eastman Kodak Company for determining the density of the spectrographs on the densitometer.

[THE BULLETIN for November–December (74: 443–541) was issued December 3, 1947.]

TABLE 1. *A taxonomic survey of fluorescence in roots.*

Species	Source of material[a]	Nature of fluorescence		
		Color	Intensity[b]	Remarks
Lycopodiaceae				
Lycopodium complanatum L. var. *flabelliforme* Fern.	3	bluish-white	+	rhizome bluish-white (++)
L. obscurum L.	3	bluish-white	+	
Selaginellaceae				
Selaginella Kraussiana A. Br.	2	bluish	++	
Equisetaceae				
Equisetum arvense L.	3	bluish-white	++	
Schizaeaceae				
Anemia Phyllitidis Swartz	2	none	roots dark	
Polypodiaceae				
Cyrtomium falcatum J. Smith	2	greenish-white	++	
Dennstaedtia punctilobula (Michx.) Moore	3	none	roots dark	acetone extract showed a bright greenish-white fluorescence
Dryopteris noveboracensis (L.) A. Gray	3	none	roots dark	rhizome greenish-white (+++)
Onoclea sensibilis L.	3	none	roots dark	rhizome parenchyma purplish (+++), vascular bundles bluish-white (+++)
Polystichum acrostichoides (Michx.) Schott.	3	none	roots dark	acetone extract showed a bright greenish fluorescence
Pteridium latiusculum (Desv.) Hieron.	3	none	roots dark	acetone extract with orange color and greenish fluorescence
Cycadaceae				
Zamia floridana DC.	2	blue	+++	root tubercles with bright red zone caused by chlorophyll fluorescence of blue-green algae
Taxaceae				
Taxus canadensis Marsh	3	bluish-white	++	
Pinaceae				
Juniperus virginiana L.	3	bluish	++	
Pinus Strobus L.	3	bluish	++	
Tsuga canadensis (L.) Carr	3	bluish	+++	

TABLE 1.—*Continued*

Species	Source of material[a]	Nature of fluorescence: Color	Intensity[b]	Remarks
Pandanaceae				
Pandanus Veitchii Hort.	2	bluish-green	+	aerial roots with bluish stele and red (chlorophyll fluorescence) cortex
Sparganiaceae				
Sparganium eurycarpum Engelm.	3	blue	+++	
Gramineae				
Agrostis palustris Huds.	1	blue	+++	brightest at root tip
A. tenuis Sibth.	1, 4	blue	+++	
Arrhenatherum elatius (L.) Mert. & Koch.	1, 4	blue	+++	
Arundinaria falcata Nees.	2	bluish	++	
Avena sativa L. (Victory)	1	blue	++++	
Bromus inermis Leyss.	1, 4	blue	+++	
Dactylis glomerata L.	1, 4	blue	+++	
Festuca elatior L.	1, 4	blue	+++	
F. rubra L. var. *commutata* Gand.	1	greenish	+++	
Hordeum vulgare L. (Wisconsin No. 38)	1, 4	blue	++++	brightest at root tip
Lolium perenne L.	1	bluish	+++	
Phleum pratense L.	1, 4	blue	++++	
Phyllostachys Castillonis Hort.	2	bluish	+++	
Poa compressa L.	1, 4	blue	+++	
P. pratensis L.	1	blue	+++	
P. trivialis L.	1, 4	blue	+++	
Secale cereale L.	1, 4	blue	+++	
Sorghum vulgare Pers. (Sudan grass)	1, 4	blue	++++	
Triticum sp. (Leaps prolific)	1, 4	blue	++++	
Zea mays L.	1	blue	++++	more whitish at root tip
Cyperaceae				
Carex vulpinoidea Michx.	3	blue	+++	
Cyperus alternifolius L.	2	blue	+++	stele brightly fluorescent; cortex dark
Araceae				
Anthurium Andraeanum Lind.	2	bluish-white	++	
Philodendron scandens C. Koch & H. Sello	2	bluish	+++	

TABLE 1.—*Continued*

Species	Source of material[a]	Nature of fluorescence: Color	Intensity[b]	Remarks
Commelinaceae				
Rhoeo discolor Hance	2	bluish	+++	whitish at root tip
Tradescantia reflexa Raf.	2	bluish	++++	
Liliaceae				
Allium Cepa L.	3	bluish	+++	
Dracaena fragrans L. var. *Massangeana* Hort.	2	blue	+++	stele brightly fluorescent; cortex fainter and more whitish
Maianthemum canadense Desf.	3	bluish	+++	
Smilax glauca Walt.	3	bluish	++	rhizome bluish-white (+++)
Iridaceae				
Iris sp.[c]	2	whitish	++	
Marica caerulea Ker.	2	greenish	++	
Sisyrinchium graminoides Bickn.	3	bluish-white	++	
Marantaceae				
Maranta leuconeura Morr.	2	bluish	+++	
Orchidaceae				
Cypripedium acaule Ait.	3	bluish	+++	
Piperaceae				
Peperomia obtusifolia A. Dietr.	2	bluish	+	
Betulaceae				
Betula lenta L.	2	bluish	++	
Ulmaceae				
Celtis occidentalis L.	2	bluish	++	
Urticaceae				
Pellionia Daveauana N. E. Br.	2	bluish-white	++	
Polygonaceae				
Rumex Acetosella L.	3	blue	+++	reddish fluorescence in brown-stained cortex
Chenopodiaceae				
Chenopodium sp.[c]	3	blue	++++	
Caryophyllaceae				
Dianthus Caryophyllus L.	1	bluish-purple	++	
Stellaria media (L.) Cyrill.	3	blue	+++	

TABLE 1.—*Continued*

Species	Source of material[a]	Nature of fluorescence: Color	Intensity[b]	Remarks
Ranunculaceae				
Aquilegia sp.[c]	2	bluish	++	
Delphinium Ajacis L.	2	greenish-white	++	
Ranunculus bulbosus L.	3	bluish	+++	bulb also bluish
Berberidaceae				
Berberis Thunbergii DC.	3	greenish-yellow	++++	
Lauraceae				
Benzoin aestivale (L.) Nees	2	bluish	++	
Cruciferae				
Alyssum maritimum Lam.	1	blue	++	
Brassica oleracea L. (Broccoli)	1	bluish-white	+++	
Iberis amara L.	1	bluish-white	++	
Raphanus sativus L.	1	bluish-white	+++	
Crassulaceae				
Kalanchoë verticillatá Elliott (=*K. tubiflora*)	2	bluish	++	
Saxifragaceae				
Saxifraga saramentosa L.	2	bluish-white	+	
Rosaceae				
Fragaria sp. (Cult. Everbearing)	3	bluish-white	++	
Potentilla simplex Michx. var. *typica* Fern.	3	bluish	++	
Leguminosae[d]				
Glycine Max (L.) Merr. (*Biloxi*)	1	bluish	+++	
Lathyrus odoratus L.	1	whitish	++	
Lespedeza capitata Michx.	3	bluish	+++	nodules bright bluish
Lupinus perennis L.	1	whitish	+	red at root tip
L. perennis L.	2	whitish	+	nodules greenish
Mimosa pudica L.	1	whitish	++	
Phaseolus aureus Roxbg. (Mung bean)	1	purplish	+	whitish at root tip
Pisum sativum L. (Little Marvel)	1	white	++++	
Trifolium hybridum L.	3	bluish	++	
Oxalidaceae				
Oxalis europaea Jordan	3	blue	+++	

TABLE 1.—*Continued*

Species	Source of material[a]	Nature of fluorescence		
		Color	Intensity[b]	Remarks
Geraniaceae				
Pelargonium domesticum	2	whitish	++	
Tropaeolaceae				
Tropaeolum majus **L.**	2	bluish-white	+++	subterranean portion of stem greenish
Rutaceae				
Citrus sinensis **Osbeck**	2	blue	+++	
Simarubaceae				
Ailanthus altissima **(Mill.) Swingle**	3	bluish	+++	present in cortex and stele of roots over 1 cm. diameter
Polygalaceae				
Polygala polygama **Walt.**	3	blue	+++	subterranean runners and cleistogamous flowers bright blue
Euphorbiaceae				
Euphorbia splendens **Bojer**	2	bluish-white	+++	
Buxaceae				
Pachysandra terminalis **Sieb. & Zucc.**	3	blue-greenish-white	+++	
Anacardiaceae				
Rhus copallina **L.**	3	blue	+++	whitish stele
Aquifoliaceae				
Ilex glabra **(L.) Gray**	2	bluish	++	
Celastraceae				
Celastrus scandens **L.**	3	blue	+++	
Aceraceae				
Acer Negundo **L.**	3	blue	+++	
Balsaminaceae				
Impatiens biflora **Walt.**	3	bluish	++	
Vitaceae				
Vitis aestivalis **Michx.**	3	blue	+++	
Malvaceae				
Hibiscus Rosa-sinensis **L.**	2	bluish	+++	
Violaceae				
Viola papilionacea **Pursh.**	3	blue	++++	
V. tricolor **L. (Pansy)**	2	blue	++++	about the brightest fluorescence observed

TABLE 1.—*Continued*

Species	Source of material[a]	Nature of fluorescence		
		Color	Intensity[b]	Remarks
Passifloraceae				
Passiflora alato-caerulea Lindl.	2	greenish-white	+++	
Cactaceae				
Zygocactus truncatus Schum.	2	bluish-white	+++	
Onagraceae				
Fuchsia speciosa Hort.	2	bluish-white	+	
Araliaceae				
Aralia nudicaulis L.	3	bluish	++	
Umbelliferae				
Apium graveolens L. var. *dulce* DC.	2	bluish	++	
Daucus Carota L. var. *sativa* DC.	1	bluish-green	+++	
Cornaceae				
Cornus florida L.	3	bluish	++++	
Ericaceae				
Kalmia latifolia L.	2	bluish	+	
Monotropa Hypopitys L.	3	bluish	+	
M. uniflora L.	3	blue	++	stems bluish (+++)
Primulaceae				
Lysimachia quadrifolia L.	3	bluish	+	rhizomes bluish
Styracaceae				
Styrax americana Lam.	2	bluish	++	very bright bluish hypocotyl
Oleaceae				
Fraxinus pennsylvanica Marsh.	3	bluish	++	
Asclepiadaceae				
Stapelia variegata L.	2	bluish	+++	
Boraginaceae				
Cynoglossum grande Douglas	1	greenish	+++	
Labiatae				
Coleus Blumei Benth.	2	bluish-white	++	
Solanaceae				
Datura Stramonium L.	1	bluish-white	++++	hypocotyl white
Lycopersicon esculentum Mill. (Rutgers)	1	purplish	++	whitish at root tip
Petunia hybrida Vilm.	1	bluish	+++	
Solanum tuberosum L.	...	...	.	tuber bluish (++)

TABLE 1.—Continued

Species	Source of material[a]	Nature of fluorescence		
		Color	Intensity[b]	Remarks
Scrophulariaceae				
Antirrhinum majus L.	1	bluish	++	
Melampyrum lineare Lam.	3	blue	+++	
Plantaginaceae				
Plantago lanceolata L.	3	blue	+++	
P. major L.	3	blue	+++	
Caprifoliaceae				
Sambucus canadensis L.	3	bluish-white	++	
Campanulaceae				
Campanula ramosissima Sibth. & Sm.	2	blue	+++	
Lobeliaceae				
Lobelia Erinus L.	2	greenish-white	+++	
Compositae				
Ageratum Houstonianum Mill.	1	whitish	++	
Ambrosia artemisiifolia L.	3	bluish	++	
Calendula officinalis L.	1	whitish	++	
Centaurea Cyanus L.	1	bluish-white	++	
Galinsoga ciliata (Raf.) Blake	3	bluish-white	++	
Helianthus annuus L.	1	bluish-white	++	
Lactuca sativa L.	1	bluish-purple	+	
Solidago rugosa Mill.	3	bluish-white	++	subterranean rhizomes bluish
S. sempervirens L. var. *mexicana* (L.) Fern.	2	bluish	+	

[a] Numbers in this column refer to sources as follows:
1: roots from seedlings growing in Petri dishes on filter paper; germinated in the laboratory at room temperature.
2: roots from plants growing in the greenhouse.
3: roots from plants growing outdoors.
4: seeds obtained through the courtesy of Peter Henderson & Co.

[b] Intensity indicated as follows: weak (+), fairly bright (++), bright (+++), very bright (++++).

[c] Species not identified because of immature condition.

[d] Legume roots without nodules unless otherwise indicated.

blue, bluish, or bluish-white (109 species). The roots of 11 species were greenish, those of *Berberis Thunbergii* having a brilliant greenish-yellow fluorescence; those of eight others were almost white. Linsbauer (1929) reported a bright yellow fluorescence in *Pisum* and a weak yellow fluorescence in *Lens,* but this color was not observed in the legumes listed here. A red fluorescence was observed in the root tips of young, dark-grown seedlings of *Lupinus perennis* and in necrotic tissue around cavities in galls on roots of this species, and in the brownish cortex of the tap root of *Rumex Acetosella.* There was no sign of green pigment in the above-mentioned tissues and the red fluorescence was probably not due to the presence of chlorophyll. Greenish aërial roots such as those of *Pandanus Veitchii,* on the other hand, showed a red chlorophyll fluorescence, as did the root tubercles of *Zamia floridana* in the zones invaded by blue-green algae.

Fluorescence was particularly bright in the roots of oats (*Avena sativa*) and in those of the pansy (*Viola tricolor*).

When the species are considered taxonomically, all but one of the *Gramineae* exhibited a bright blue fluorescence, while the *Leguminosae* and *Compositae* seemed to have substances exhibiting a white or whitish fluorescence predominating.

One may conclude from these observations that fluorescing substances have a wide distribution in the roots of vascular plants. The differences in color of the fluorescence in the various species examined suggest that a number of compounds must be responsible for the fluorescence. Mixtures of blue-, green-, and white-fluorescing compounds could account for all of the colors observed with the exception of the yellows and reds.

Extraction of the Fluorescing Material. The fluorescent substances may be readily extracted from roots by various solvents such as n-butanol and aqueous acetone. Table 2 shows the results obtained by extracting the roots of six different species of Angiosperm seedlings. The seeds were germinated in Petri dishes on filter paper, or those of *Pisum* in pots of sand. The roots were removed and ground in a mortar with several changes of solvent. Each extract was centrifuged and decanted from the cellular debris. The solvent was then evaporated to a convenient volume, and the residual extract diluted with water or with 50 per cent aqueous ethanol to give a concentration five times that to be tested fluorometrically. One ml. of this diluted extract was placed in a cylindrical, calibrated cuvette 13 mm. in diameter and buffer solution added to the 5 ml. mark. The fluorescence was measured on a Klett fluorimeter-colorimeter,[3] an instrument designed and described by Kavanagh (1941). The fluorescence standard was a solution of 1 mg. quinine sulfate per liter 0.1 N H_2SO_4. Lamp filters were Corning No. 5970 and photocell filters, Corning No. 3389 for both standard and unknown.

[3] This instrument was purchased with a grant to the senior author from the Rumford Committee of the American Academy of Arts and Sciences.

TABLE 2. *Fluorescent activity of raw extracts of roots.*

Species	Age of seedlings in days	Number of seedlings extracted	Extracting solvent	pH giving maximum fluorescence	Number of plants giving fluorescence equivalent to 1 mg. quinine/liter
Avena sativa No. 1	4	60	n-butanol	9.0	1.0
" " No. 5	3	1,620	"	8.2	0.6
" " No. 7	4	220	acetone	9.0	0.5
" " No. 8	3	200	"	8.0	0.6
" " No. 13	4	250	"	9.0	0.3
Hordeum vulgare	4	50	n-butanol	10.9	25
" "	4	500	"	9.1	18
Phleum pratense	5	ca. 8,000	"	10.9	ca. 3,400
" "	5	ca. 28,000	"	9.1	ca. 3,500
Triticum sp.	4	50	"	9.5	26
" "	4	500	"	9.1	31
Pisum sativum	7	18	"	8.2	2.8
Lycopersicon esculentum (red pear)	9	120	"	10.9	74
" " (Rutgers)	7	700	"	10.8	344

TABLE 3. *A comparison of the properties of three fluorescing fractions of Avena root extracts.*

Fraction A	Fraction B	Fraction C
Soluble in water, 95% aqueous ethanol, n-butanol, chloroform, aqueous acetone	Soluble in water, 95% aqueous ethanol, n-butanol, chloroform, dry acetone, dry benzene	Soluble in water, 95% aqueous ethanol, n-butanol, chloroform
Insoluble (or nearly so) in dry acetone, dry benzene and petroleum ether	Insoluble in petroleum ether	Insoluble in petroleum ether
Adsorption on powdered alumina strong	Adsorption on powdered alumina weak	Adsorption on powdered alumina intermediate between that of fractions A and B
Fluorescence bright blue; intensity decreasing sharply at pH values below 3 to about 10% of that at the higher pH values	Fluorescence greenish in alkaline and bluish in acid solution; intensity decreasing between pH 9 to 5	Fluorescence bright blue; intensity not showing marked change with change of pH
Extracted from chloroform by dilute HCl	Not so effectively extracted from chloroform by dilute HCl	Extracted from chloroform by dilute HCl
Partially precipitated from acid solution when the solution is extracted with chloroform. This step must apparently be preceded by repeated shaking of the aqueous extract with benzene	Not precipitated from acid solution when the solution is extracted with chloroform	Not precipitated from acid solution when the solution is extracted with chloroform

The buffers used were McIlvaine's citric acid—disodium phosphate buffers as given in the *Handbook of Chemistry and Physics*, except for pH values 1.4, 2, 9, 10, and 11.3. The pH 1.4 solution was obtained with 0.1 N H_2SO_4; the pH 2 buffer was made by adding 2 ml. 2 N H_2SO_4 to 100 ml. 0.1 M citric acid; the pH 11.3 buffer was 0.2 M Na_2CO_3; the pH 9 and 10 buffers were made by mixing 0.2 M Na_2CO_3 and 0.2 M Na_2HPO_4. The pH of the extract-buffer mixtures were usually tested immediately after the fluorescence determinations on a Leeds & Northrup pH meter (a Beckman high pH electrode was used to measure pH 11.3), and in no case had the pH of the original buffer solution been changed by more than 0.2 pH unit. The measured pH of the mixture is always the one here reported.

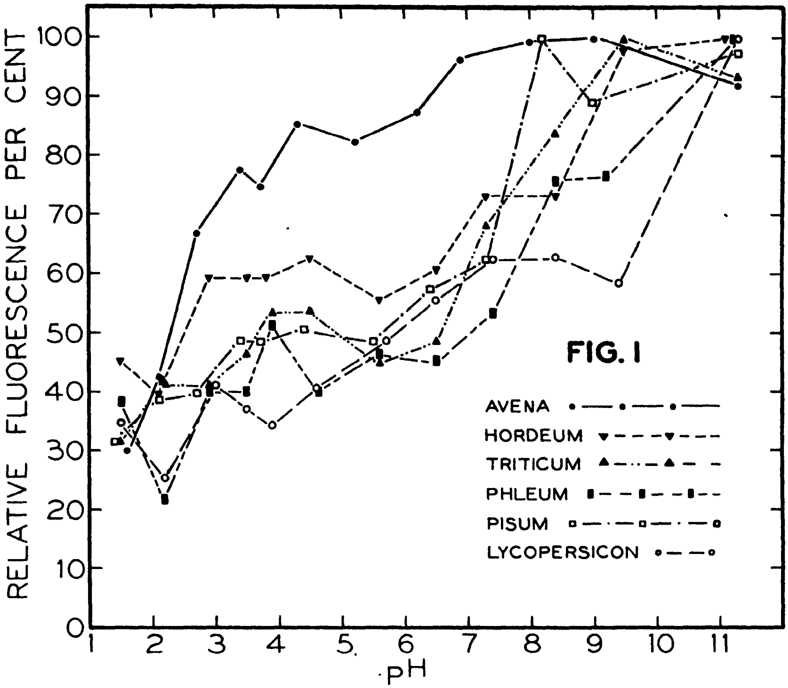
Each extract was tested in a complete series of 10–13 different buffers. The values for each extract given in table 2 are maximum values obtained for the buffer series, and the pH at which each maximum was obtained is given. No data are available for comparison of fluorescence in terms of weight of tissue extracted. However, *Avena, Hordeum,* and *Triticum* had root systems of comparable size per plant, while *Pisum* had a larger root system per plant than the cereals, and *Lycopersicon* a somewhat smaller one. *Phleum* seedlings had a single, very fine, thread-like root; at least 100 to 200 of these were probably equivalent to the root system of one *Avena* seedling. On this basis, it can be seen that *Avena* is by far the richest source of fluorescing substances of the six species extracted.

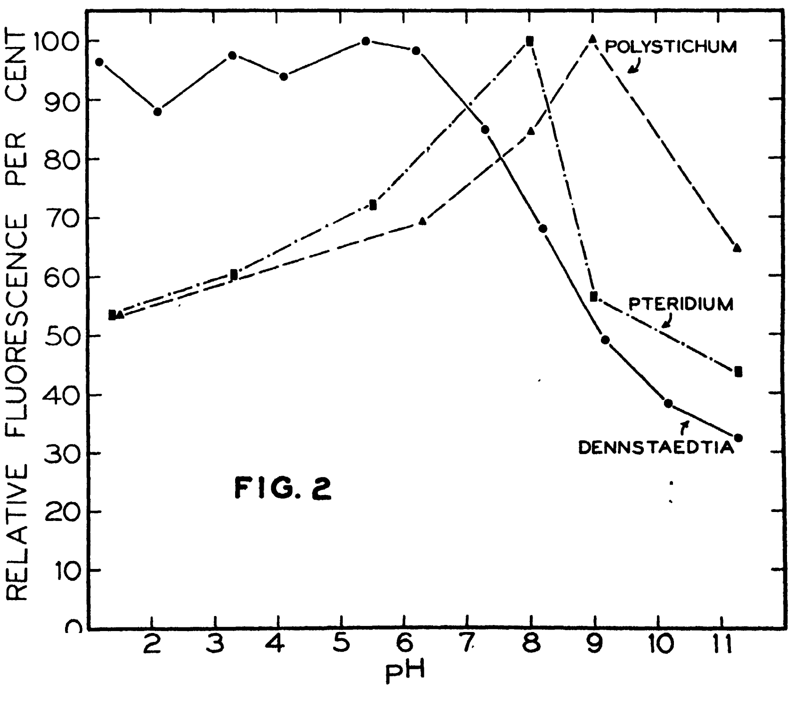
The Fluorescence of the Extracts as a Function of pH. The fluorescence of organic compounds usually varies markedly with the hydrogen ion concentration of the solute. The shapes of the pH-fluorescence curves for a number of pure compounds have been found to be very characteristic (Ellinger & Holden 1944; Huff 1947; Kavanagh & Goodwin in press). Hence, the shapes of the pH–fluorescence curves for extracts are of interest as suggesting the possible nature of the predominating fluorescent substances in the extracts. Differences in the shapes of such curves would indicate differences in the fluorescing substances present.

For each extract tested, the relative fluorescence in the buffer series was calculated as a percentage of the maximum fluorescence obtained. The pH-fluorescence curves for an extract from the roots of each species listed in table 2 are shown in figure 1. The curves for *Hordeum, Triticum, Phleum,*

Explanation of figures 1 and 2

Fig. 1. The relationship between relative fluorescence and pH for n-butanol extracts of the roots of six different species of Angiosperms, *Avena sativa, Hordeum vulgare, Triticum* sp. (Leaps prolific), *Phleum pratense, Pisum sativum,* and *Lycopersicon esculentum.* FIG. 2. The relationship between relative fluorescence and pH for acetone extracts of the roots of three different species of ferns, *Polystichum acrostichoides, Pteridium latiusculum,* and *Dennstaedtia punctilobula.*


RELATIVE FLUORESCENCE PER CENT
pH
FIG. 1
AVENA
HORDEUM
TRITICUM
PHLEUM
PISUM
LYCOPERSICON


RELATIVE FLUORESCENCE PER CENT
pH
FIG. 2
POLYSTICHUM
PTERIDIUM
DENNSTAEDTIA

Pisum, and *Lycopersicon* are quite similar. The fluorescence is greatest in the alkaline range and drops off gradually to lower values in acid solutions. The pH–fluorescence curve for *Avena* differs from the others in having relatively high values from pH 8 to pH 3 with a sharp drop between pH 3 and pH 2. This indicates the presence of a relatively large amount of one or more chemical compounds not found in appreciable amounts in root extracts of the other species.

Acetone extracts have been made of the roots of three species of ferns, *Polystichum acrostichoides*, *Pteridium latiusculum*, and *Dennstaedtia punctilobula*. These extracts, when tested, gave the very different pH–fluorescence curves shown in figure 2.

Fractionation of Avena Extracts. It has been found possible to fractionate n-butanol and aqueous acetone extracts of *Avena* roots and to obtain three or more fluorescing fractions, each having quite different chemical properties. These fractions can be distinguished by their characteristic pH–fluorescence curves. Figure 3 shows pH–fluorescence curves for three separate fractions obtained from *Avena* root extract No. 10. The extraction and fractionation procedures employed are given in the legend to the figure. These curves are typical for the three fractions. Preparations yielding such curves have been made repeatedly and by various methods. Some of the properties of these three fractions are given in table 3.

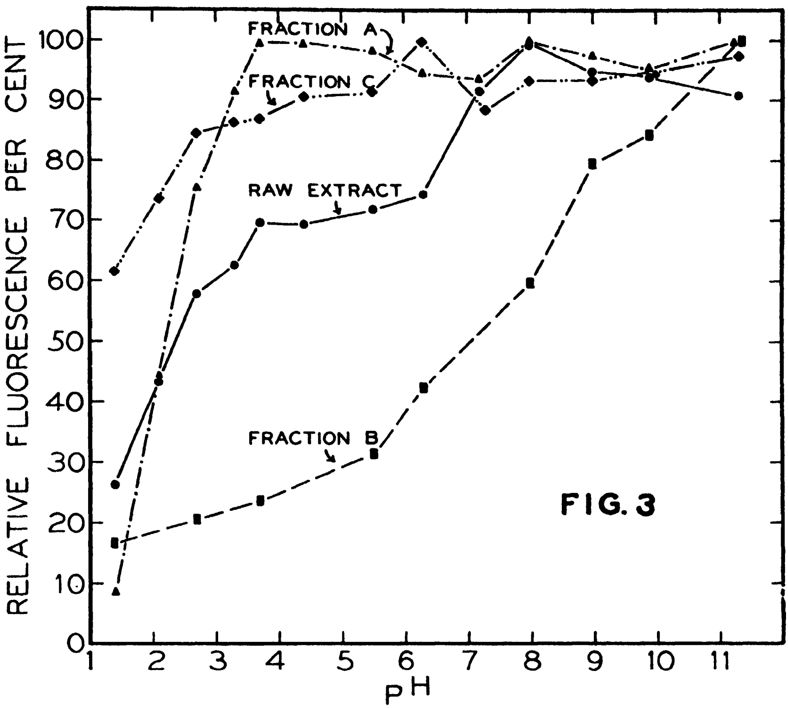
Details of the chemical part of this investigation will be reported elsewhere (Kavanagh & Goodwin in press; Goodwin, Kavanagh & Stafford in press). The principal blue-fluorescing substances in *Avena* roots cannot be

Explanation of figures 3 and 4

FIG. 3. The relationship between relative fluorescence and pH for three different fractions of *Avena* root extract No. 10.

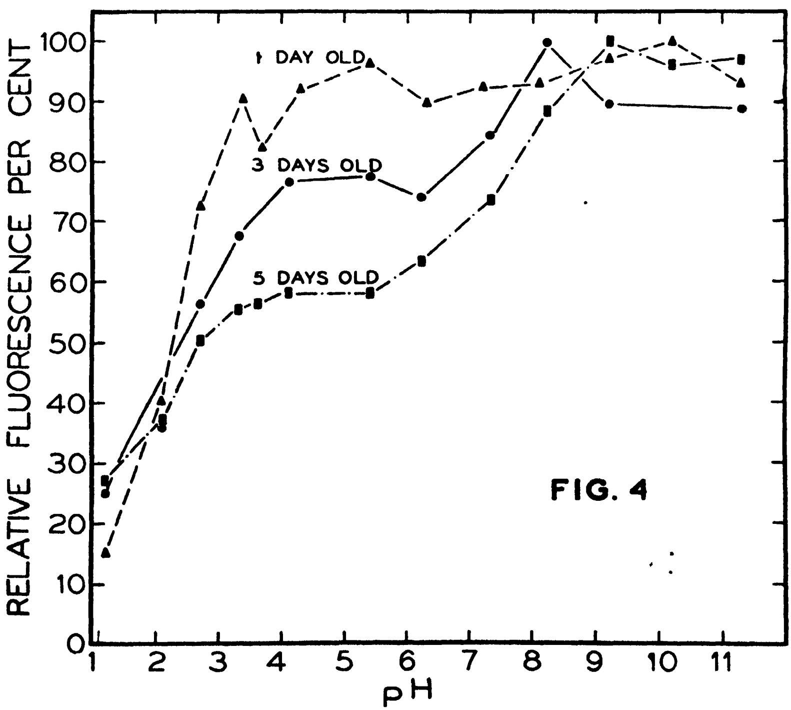
The roots of 200 three-day-old seedlings were extracted repeatedly with a total of 50 ml. acetone. The fluorescence of a portion of this extract was tested. The acetone was evaporated, and the remaining 3 ml. aqueous extract was made up to 10 ml. with water and was shaken 5 times with 10 ml. portions of benzene. The milky aqueous fraction was acidified with 1 ml. 1 N HCl and then shaken with 10 ml. portions of chloroform. A white precipitate fell to the interface between the aqueous acid and the chloroform layers during the second extraction with chloroform. This precipitate (*fraction A*) was removed, dissolved in 5 ml. acetone, diluted with water and the fluorescence tested. The remaining acid solution was decanted, neutralized with NaOH, filtered through a small pyrex funnel, evaporated to 2 ml., and adsorbed on a column 50 cm. long and 6 mm. in diameter of powdered anhydrous aluminum oxide which had been heated for 30 minutes at 300° C. immediately before use. The chromatogram was developed with 3 ml. water until some of the fluorescing materials had travelled 32 cm. down the column. The basal 3 cm. of the chromatogram fluoresced light green and were eluted with water to give *fraction B*. The next 26 cm. fluoresced bright blue. The lowest 3 cm. of this zone were discarded and the next 11.5 cm. were eluted with water to give *fraction C*. The top 11.5 cm. of the blue zone gave a pH curve nearly identical to that of the white precipitate (*fraction A*).

FIG. 4. The pH-fluorescence curves for acetone extracts of the roots of *Avena* seedlings of different ages.



FRACTION A
FRACTION C
RAW EXTRACT
FRACTION B
RELATIVE FLUORESCENCE PER CENT
pH

FIG. 3



1 DAY OLD
3 DAYS OLD
5 DAYS OLD
RELATIVE FLUORESCENCE PER CENT
pH

FIG. 4

identified with the following fluorescent organic compounds which might possibly be found in plant tissues: vitamin A, thiochrome, riboflavin, glucoflavin, lumilactoflavin, gluco-iso-alloxazine, bis-imino-alloxazine, the n-butanol derivative and at least one of the acetone derivatives of N^1-methyl-

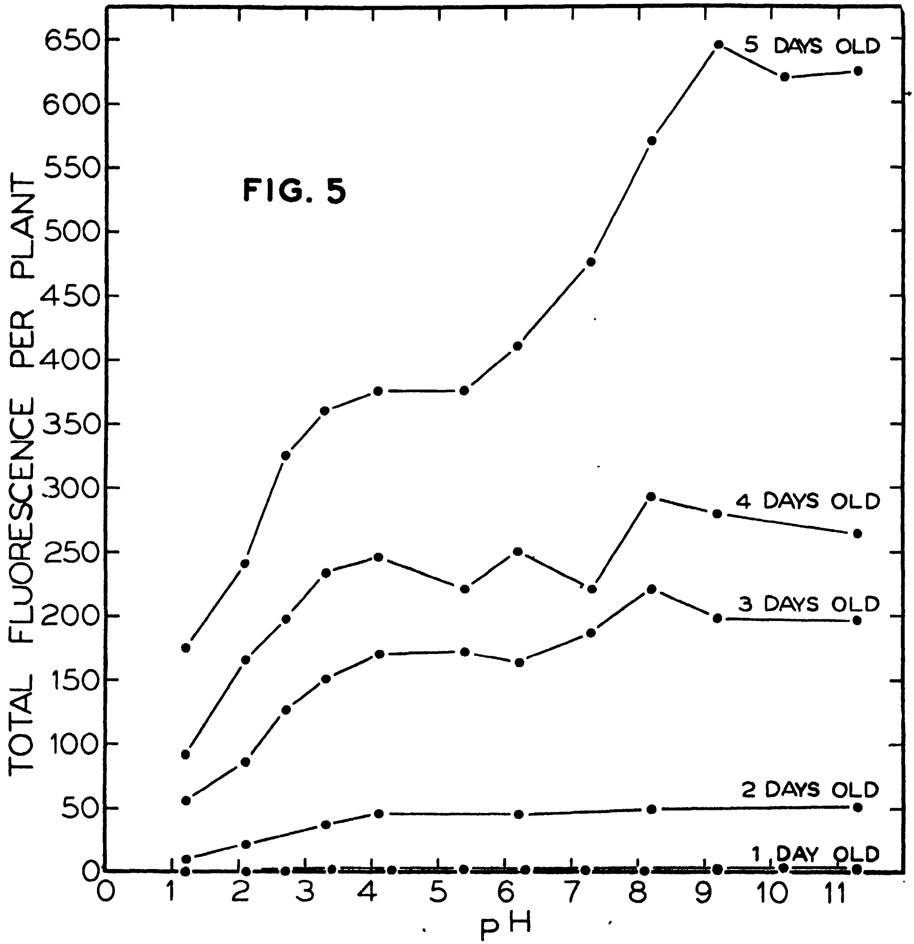


FIG. 5. Total fluorescence per plant of root extracts measured at several pH values and at five stages during germination. Quinine sulfate at 1 mg. per liter had a fluorescence of 100.

nicotinamide, 2-amino-4-hydroxy-pteridine-6-carboxylic acid, 2-amino-4-hydroxy-pteridine-6-methanol, 4-pyridoxic acid lactone, leucopterin, xanthopterin, anthranilic acid, di-iso-barbaturic acid, quinine, phytofluene, and terthienyl.

Biosynthesis of the Fluorescent Material in Avena. *Avena* seeds were germinated in the laboratory on filter paper in Petri dishes. The root systems

of the seedlings were sampled at daily intervals, extracted with acetone, and the fluorescence measured. An examination of the pH-fluorescence curves for extracts of roots of various ages (figure 4) reveals the presence of a relatively high proportion of "fraction A" in the one-day-old roots, and a progressively larger proportion of "fraction B" in the roots of the older seedlings. Thus the *Avena* extract from five-day-old roots has a pH-fluorescence curve quite similar to those obtained for the other species shown in figure 1.

The fluorescence of the extracts at various pH values, expressed as potentiometer units per plant, is shown in figure 5. In five days there is a two-hundred-and-fifty-fold increase in the blue-flourescing substances over the amount extractable from the dormant seed.

SUMMARY

The roots of 135 species of vascular plants representing 69 families have been examined in ultra-violet light; of these all but six species of ferns with much dark pigment in the roots exhibited fluorescence. The color of the fluorescence was most frequently blue, bluish, or bluish-white, but was sometimes greenish, greenish-yellow, or red.

The fluorescing substances have been extracted with acetone or with n-butanol from the roots of nine different species, including three of the above-mentioned ferns.

The blue-fluorescing material extracted from *Avena sativa* roots has been separated into at least three distinct fractions. Some of the chemical properties of these fractions are briefly reported. Biosynthesis of these fluorescing substances occurs during the first few days after germination.

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Literature Cited

Ellinger, P. & Holden, M. 1944. Quenching effect of electrolytes on the fluorescence intensity of riboflavin and thiochrome. Biochem. Jour. **38**: 147–150.

Goodwin, R. H. 1941. On the inhibition of the first internode of *Avena* by light. Am. Jour. Bot. **28**: 325–332.

Goodwin, R. H., Kavanagh, F., & Stafford, Helen. [In press.] Blue fluorescing fractions extractable from the roots of oats.

Huff, J. W. 1947. The fluorescent condensation product of N[1]-methylnicotinamide and acetone. I. Synthesis and properties. Jour. Biol. Chem. **167**: 151–156.

Kavanagh, F. 1941. New photoelectric fluorimeter and some applications. Ind. & Eng. Chem. Anal. Ed. **13**: 108–111.

Kavanagh, F. & Goodwin, R. H. [In press.] The relationship between pH and fluorescence of several organic compounds.

Linsbauer, L. 1929. Über Fluoreszenzerscheinungen an Wurzeln. Bot. Archiv. **23**: 441-444.

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AN ACTION SPECTRUM FOR INHIBITION OF THE FIRST INTERNODE OF AVENA BY LIGHT

RICHARD H. GOODWIN AND OLGA V. H. OWENS

Various physiological processes are profoundly affected by radiant energy. This energy must be absorbed before it can have a photochemical effect. In many cases specific chemical compounds are responsible for this absorption. Information concerning the nature of the absorption spectrum of a compound of this sort can be secured by determining the action spectrum of the particular phenomenon under consideration, that is, the relationship between the reciprocal of the amount of monochromatic radiant energy required to produce a constant physiological effect and the wave-length. An action spectrum may differ from the absorption spectrum of the active compound for various reasons, one of them being the presence in the tissues of interfering pigments.

A number of investigations on the effectiveness of various regions of the spectrum in inhibiting elongation of the first internode of *Avena* seedlings have shown that red light is most effective in bringing about such inhibition (2, 3, 5, 7, 10, 11). The most light-sensitive phase of this inhibition is due primarily to a reduction in the number of cell divisions in the internode (1, 5). A tentative action spectrum for this phenomenon was published by Weintraub and McAlister (10), and this has been recently revised by Weintraub and Price (11) to include further data. Weintraub and his collaborators have used continuous irradiations of very low intensity to produce their inhibitions.

In this paper the authors wish to present an action spectrum for internode inhibition produced by very short exposures of higher intensity. The details of these experiments will be reported elsewhere. An outline of the experimental procedure is as follows. Seeds of *Avena sativa* var. "Victory" were husked, laid out on moist absorbent cotton—thirty to a dish, and grown in complete darkness in 90 per cent relative humidity and at a temperature of 25° C. After 1.5 days, when the first internodes were 2.2 mm. long, the seedlings were irradiated with monochromatic light isolated from mercury and sodium arc spectra by means of glass and liquid filters. The intensity of the exposures was measured with a calibrated electronic photometer; the time was varied between 1 and 1,800 seconds. The plants were then returned to the dark, and the lengths of the internodes measured at the age of five days. By this time the first internodes had completed their growth, the dark-grown controls having attained an average length of 67 mm. The inhibition

was calculated by dividing the average decrease in length of the irradiated internodes over that of the dark-grown controls by the average length of the internodes of the dark-grown controls. The amount of energy required to give a 10 per cent inhibition at each wave-length was determined from graphs showing the relationship between percentage inhibition and total energy of irradiation. The reciprocals of these values, corrected for their quantal content, are shown in figure 1. The values reported by Weintraub and his collaborators (10, 11) are also shown for comparison.

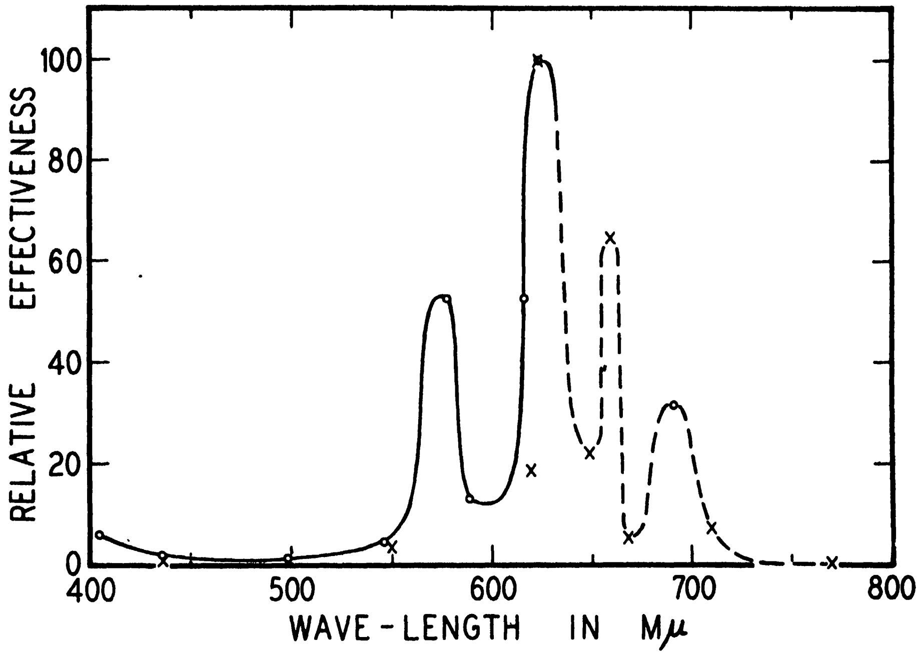

FIG. 1 An action spectrum for the inhibition of the first internode of *Avena*. Ordinates are proportional to the reciprocals of the quanta required to produce a given amount of inhibition and are expressed as percentages of the highest value. Circles represent our data for a 10% inhibition produced by short exposures. Crosses are for the data of Weintraub and Price (11), who used continuous illumination. A solid curve has been drawn through our data between 400 and 630 mμ. A broken line has been drawn between all the available points at longer wave-lengths. It is not at all certain that the action spectrum obtained by using short exposures would follow the curve in this region of the spectrum (see discussion in the text).

This action spectrum shows maxima in the red at 623 mμ and in the yellow at 577 mμ. The latter peak has not to our knowledge been previously reported. It seems highly significant that the positions of these maxima coincide with maxima between 620 and 629 mμ and between 560 and 576 mμ reported for protochlorophyll (4, 8, 9), a pigment which has been shown to

be present in etiolated oat seedlings (4, 6). There is no indication of a maximum in the blue at 436 mμ, which is very close to the protochlorophyll maximum at 440 mμ. The reason for this may well be that the large quantities of carotenoid pigments present in the seedlings (4) are acting as a color filter at this wave-length.

The maximum in the action spectrum at 660 mμ reported by Weintraub and Price (11) does not coincide with any protochlorophyll absorption band, but does fall directly on the main chlorophyll *a* absorption maximum. It has been shown that chlorophyll *a* is the first of the two chlorophyll components to be formed in etiolated oat seedlings upon exposure to light (6). It is possible that chlorophyll *a*, as well as protochlorophyll, may be effective as an absorbing pigment in the internode inhibition mechanism, and that enough chlorophyll synthesis occurs during long, very weak exposures to account for the maximum in the action spectrum reported at 660 mμ. If this were the case, one would predict that there would be no maximum in the action spectrum at this wave-length, if very short exposures were used. We have not yet been able to check this interesting possibility.

The maximum in the action spectrum at 691 mμ, located at the only point which we have determined in this region, has not been correlated with peaks in the absorption spectra of protochlorophyll or of chlorophyll *a*. Its presence was indicated in the action spectrum of Weintraub and Price (11), but the actual position of the maximum appears to be at a shorter wave length than was shown by their data.

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Literature Cited

1. **Avery, G. S., Jr., Burkholder, P. R. & Creighton, H. B.** Polarized growth and cell studies in the first internode and coleoptile of *Avena* in relation to light and darkness. Bot. Gaz. **99**: 125–143. 1937.
2. ————. Growth and cell structure in the first internode and coleoptile of *Avena* as affected by red, green, blue, and violet radiation. (Abstract.) Am. Jour. Bot. **25**: 10s. 1938.
3. **Du Buy, H. G. & Nuernbergk, E.** Weitere Untersuchungen über den Einfluss des Lichtes auf das Wachstum von Koleoptile und Mesokotyl bei *Avena sativa*. Proc. Akad. Wetenschap. Amsterdam **32**: 808–817. 1929.
4. **Frank, Sylvia R.** The effectiveness of the spectrum in chlorophyll formation. Jour. Gen. Physiol. **29**: 157–179. 1946.
5. **Goodwin, R. H.** On the inhibition of the first internode of *Avena* by light. Am. Jour. Bot. **28**: 325–332. 1941.
6. **Goodwin, R. H. & Owens, Olga v. H.** The formation of chlorophyll *a* in etiolated oat seedlings. Plant Physiol. **22**: 197–200. 1947.
7. **Johnston, E. S.** Growth of *Avena* coleoptile and first internode in different wave-length bands of the visible spectrum. Smithson. Misc. Coll. **96** (6): 1–19. 1937.

8. **Noack, K. & Kiessling, W.** Zur Entstehung des Chlorophylls, und seiner Beziehung zum Blutfarbstoff. I. Mitteilung. Zeits. Physiol. Chem. **182**: 13–49. 1929.
9. **Strain, H. H.** Leaf xanthophylls. Carnegie Inst. Wash. Publ. **490**: 1–147. 1938.
10. **Weintraub, R. L. & McAlister, E. D.** Developmental physiology of the grass seedling. I. Inhibition of the mesocotyl of *Avena sativa* by continuous exposure to light of low intensities. Smithson. Misc. Coll. **101** (17): 1–10. 1942.
11. **Weintraub, R. L. & Price, L.** Developmental physiology of the grass seedling. II. Inhibition of mesocotyl elongation in various grasses by red and by violet light. Smithson. Misc. Coll. **106** (21): 1–15. 1947.

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A PHYSICAL ANALYSIS OF THE OPENING AND CLOSING MOVEMENTS OF THE LOBES OF VENUS' FLY-TRAP

OTTO STUHLMAN, JR.

Few botanical mechanisms have aroused so much interest, in the field of the "carnivorous," as the trap-like structure at the end of the spatulated petiole of *Dionaea muscipula.*

Lloyd (1), in his monograph on "The Carnivorous Plants," described the trap as consisting of two lobes, united along the middle line by a thick midrib, which has often been considered a hinge, but which has no hinge action. The lobes have their greatest thickness at the base but become thinner gradually as the margin is approached, where they thicken locally by the enlarged bases of the marginal spines. These are prominent, tapering,

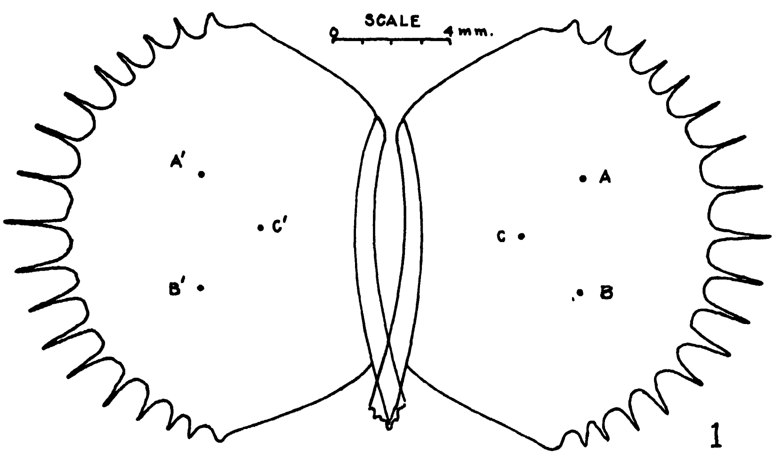


FIG. 1. Scale drawing of the inner surfaces of the lobes of *Dionaea muscipula,* showing the relative positions of the trigger-hairs with respect to the margins of the lobes.

finger-like processes which Solereder (2) opines are emergences. They are so placed that when the two concave surfaces of the lobes close, the spines approach each other and interlace like the fingers of closed hands.

On each inner surface of the concave sides of the lobes are usually found three spike-like organs. Figure 1 shows their average relative positions. They are described by Lloyd as located at the angles of a triangle placed in the middle of the lobe with its base nearer and parallel to the outer ciliated margin.

The closure of the trap, according to Lloyd, is "a seismonastic movement." This movement normally follows when the sensitive or trigger-

hairs are disturbed, as Curtis recorded as early as 1834. Lloyd (p. 188) states that Darwin described the closure of the trap as passing through two phases. "There is at first a sudden response, bringing the edges of the lobes into some approximation, enough at least to bring the cilia (marginal spines) in position so as to make a sort of cage which can prevent the escape of sufficiently large prey. This is followed by a slow movement during which the lobes are closely apposed, pressing together, their marginal regions curved outwards." These will be referred to as the shutting and narrowing phases of closure to bring the descriptions in line with Ashida's (3) studies on the leaf movements of *Aldrovanda vesiculosa.*

The closure movements, according to Batalin (4), are accompanied by a contraction of the upper or inner surface, and a comparable expansion of the lower surface of the lobes which takes place both in a longitudinal and transverse direction. Brown's (5) measurement, after allowing for changes in surface curvature, indicated however that the surfaces did not change in area by amounts greater than the experimental error.

When the lobes are separated they retain this position as if they were under tension. By applying a sufficiently large torque to the end of a trigger-hair, the resulting stimulus seems to destroy a state of internal equilibrium upsetting the balanced forces and torques so that closure rapidly follows. Reduced to its simplest form, the stimulus starts a train of events resulting in a sudden reduction of the stresses retaining the lobes in their open position.

Since closure is known to take place in a fraction of a second, the releasing activity has been attributed to a sudden loss of turgor of the inner epidermis, which need not proceed beyond an initial stage, before a mechanical collapse of the frame of the structure sets in.

The nature of the stresses and the types of motions that are exhibited during the closing and opening movements of the lobes have, however, never been analyzed in terms of fundamental physical principles.

The present analysis of the movements of the lobes was undertaken to establish the fundamental dynamical laws governing the opening and closing movements common to all sizes and ages of traps, to determine the controlling factors producing the changes in speed and configuration of the movements, the influence of the geometrical distribution of the trigger-hairs on the degree and order of the activities of the lobes, to measure the time elapsing between excitation and response, and then to hypothecate a hydrostatic mechanism that will possess all of the above established properties and relations, with the hopes that the plant physiologist can use these established dynamic activities of the plant in the furtherance of his study of the irritable mechanism causing the sudden changes in turgor of plant cells.

The Opening Movements of the Lobes. The opening of the leaf trap, after it has unrolled from the blade, is considered as due to its slow enlargement by growth. The initial opening of the trap is unquestionably a growth process; the separation of the lobes is asymmetric in that the apex of the trap opens last.

Any subsequent openings after the trap has been excited to closure should also be indicative of a growth process and be representable as a classical sigmoid growth curve whose graphical differentiation should produce a typical distribution in time curve showing the progressive changes in speed of the opening motions of the trap.

The opening movements were followed with the aid of a traveling micrometer microscope with Ramsden eyepiece. The cross hairs were focused on the external margins of the closed trap at the point of highest curvature, halfway between the apex and base of the lobes, and the chords of the arcs described by the edges of the leaf were measured. Typical mesurements were evaluated from large, green, young traps that were recovering for the first time from their initial, mechanically stimulated, closure. These traps were excited to closure by vigorously tilting either one of the lower trigger-levers C or C′ of figure 1, with the aid of a fine steel wire terminating in a small hook.

Curve CSGA, figure 2, represents a typical set of data showing the progressive increase in the linear separation of the margins of the lobes as a function of time. This appears to be a typical sigmoid growth curve. If successive increments in this linear displacement are plotted as a function of time, the broken graph B, then represents the apparent speed with which the lobes separate. This distribution could have been equally well obtained by graphically differentiating the linear displacement curve CSG.

The ascending phase of this velocity distribution curve B is slightly steeper than the descending phase. The maximum reflects the property of the point of inflection of the sigmoid curve showing that at this point, a transition takes place from an increasing to a decreasing speed in the opening movements.

Ideally the growth curve should have a symmetrical S-shaped structure, depicting a geometrically expanding phenomenon in time subjected to self-imposed limitations which, starting at the point of inflection, produce the phase of retardation. It was conjectured that the shape of the basic curve may have been influenced by the duration and distribution of sunlight on the plant which affected the speed of the opening. Hence traps were sprung at various times during the day so that the initial opening phase took place under a variable intensity of diffuse daylight in the month of May. The

evaluated observations were obtained when the room temperature of the air was 25° C.

In the typical example presented in graph CSGA, figure 2, the trap was sprung at time 1530. Two and one-half hours later the first appreciable increase of distance between the inner edges of the margins of the lobes was observable as a 0.1 mm. separation. Subsequent measurements showed the separation of the lobes to proceed at a rapid pace until they were about half open, as indicated by the maximum in the broken distribution curve. From this point onward the movements gradually decreased in speed. After 28 hours the increments of displacement per hour suddenly increased at G, indicating a departure from the phase of retardation in the opening movements.

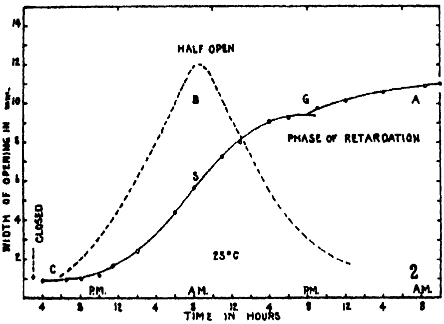
Various traps of about equal maturity were later excited to initial closure at time 830, 1030, 1500, and 1900 so that the period of darkness was distributed throughout the various phases of the opening movements. In all cases the half-open position seldom departed by more than an hour from its associated point of inflection on the typical sigmoid growth curve shown in figure 2. The ideal limitations set on the acceptability of the results were such that the traps of necessity must be excited to closure by stimulating identically located trigger-hairs with identical applied torques, despite the different physiological conditions of individual leaves, which at a given time and place may not produce identical but will give dynamically similar responses.

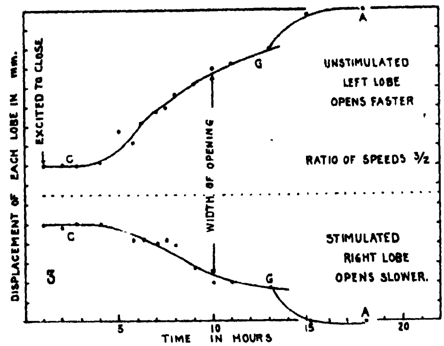
While many variations from the ideal conditions were rejected, the results on the whole showed that no basic variations, in the form of the growth curve, were observed except those attributable to changes in the degree of excitation and the variation in the trigger-hair-pattern used to stimulate the trap to closure.

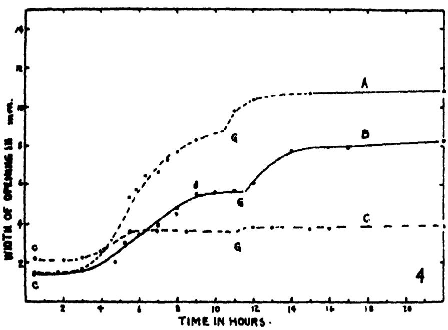
Since the distribution curve (B) showed a rapid change in speed during the middle period of its opening phase, and since a decrease in speed is attributable to the introduction of a frictional force factor it was suspected that the interlocking marginal spines were the cause of the phase of retardation.

It was found, however, that the marginal spines were always disengaged before the opening exceeded the half-open position (S). Subsequent changes in the slope of the growth curve cannot therefore be attributed to any frictional retarding force contributed by the marginal spines. One of the sources of error, in evaluating a typical situation, was however found to be due to one or more crooked overlapping spines. This entanglement did introduce a hang-back-force which modified the basic opening motion until the spines were disengaged.

To prove that the presence of the marginal spines did not contribute modifications in the basic opening motion, comparable traps were examined for changes in opening speeds before and after the spines had been clipped







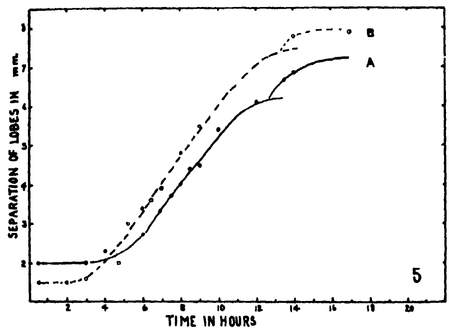


FIG. 2. Typical example of the opening movements of the trap in terms of the linear separation of the margins in time. Initial phase C shows that at the start the lobes separate slowly but progressively move faster until about half open. At this point the phase of retardation sets in, and is completed at G. Phase GA is interpreted as the reversion to the basic growth curve after complete recovery from excitation has taken place. Broken curve shows rate of separation of lobes with time. Maximum speed is attained at B, reflecting the point of inflection S of the displacement curve. FIG. 3. The movements of individual lobes show that the spreading phase of the recovering lobes CG differs from growth movements GA. CGA is interpreted as a composite motion due to two processes. Recovery is completed at G where the built-up hydrostatic pressure restored the lobes to their near preclosure position. This is followed by the phase GA which represents the rate of separation due to normal growth. FIG. 4. Recoveries from successive stimulations producing closure. The first recovery is A, the second is represented by B, while C is the fourth recovery. Relative changes in slope indicate degree of progressive inability of the lobes to recover from the previous excitatory process. FIG. 5. Curve A shows the rate of separation of the lobes after a vigorous stimulation. B, the opening of the same trap after stimulation due to a single lower trigger-hair C. Results show recovery of B to be faster than A, despite data B antidating A.

close to the margins of the lobes. This technique was permissible because Munk (6), as early as 1876, had noticed that stimulation was not procurable by cutting the outer marginal zone of the cilia.

It was found that the absence of the marginal spines did not change the form of the basic recovery curve.

In order to explore the persistence of what at first sight appears as an error in the observations at G in figures 2, 3, and 4, and where the data depart from the smooth basic curve, the movement of the individual lobes, in the process of opening, was measured.

The departure from the basic opening curve is shown in detail in figures 3 and 4, at G. Apparently, the phase GA identifies a real departure from the basic recovery phenomena depicted by the graph CSG in figure 2. It is attributed to the dominance of the normal growth process, in the life history of the leaf, after the lobes have recovered from the excitatory process, and have re-established their normal rate of growth.

Figure 3 shows the linear displacement of the left and right lobes of a large young trap that possessed no irregular interlocking marginal spines. This trap was sprung at time 1300 in diffused (May) daylight at 25° C. The observations extended over a period of 18 hours. Two hours after closure the lobes began to separate.

It can be seen that a measurable recovery from closure did not set in as an observable movement until several hours after closure. The faster moving left lobe had a recovery period of two hours, while the stimulated right lobe developed a measurable movement after a recovery period of four hours.

The relative slopes at the half open stage of the two recovery curves indicate that the left lobe was moving about 50 per cent faster than the right lobe. Despite the asymmetry of the movements, the maximum open position has within the limits of interpolation, been attained in about the same time in both lobes.

In order to produce more symmetric opening movements of the lobes, it was found necessary to stimulate both lobes in identical ways. This can be accomplished by applying equal torques simultaneously to the two symmetrically placed trigger-hairs C and C′. A difficult, and more often than not, an unsuccesssful technique.

A close approach to symmetric opening movements were obtained, after closure movements were induced, by sweeping over all six trigger-hairs in one motion with sufficient force to produce symmetrical closure.

If C on the right lobe was used as a source of the stimulus, the right lobe moved faster than the left lobe on closure. On recovery (opening) the right lobe moved more slowly. In general, the lobe to which the mechanical stimulus was applied opened more slowly than the opposite unstimulated lobe. This raises the question of the exact functional relation between the speed of recovery and intensity of the excitatory process, producing closure at a given temperature.

Recovery from Repeated Closure Movements. The lobes of a trap, after their first collapse due to a just sufficient stimulus to produce closure, will reopen (at 25° C) as illustrated in figure 4, graph A. The rapidity of the recovery is indicated by the general slope of the sigmoid curve. The recovery from the stimulus is presumably completed at G. Apparently the slower normal growth phenomenon was screened by the more rapid recovery movements, so that the remainder of the graph GA can now be attributed to a reversion to the normal speed of the leaf growth.

Twenty-eight hours later the same trap was sprung once more, by mechanically exciting the same trigger-hair in the same way. Its opening movements are depicted by graph B. The general slope of this graph is less than the slope of A. It is therefore moving much more slowly during its second opening than during its first opening movements.

Graph C in figure 4 shows the opening movements of the trap after it had been stimulated to closure the fourth time. Its recovery is now very slow in its initial phase of opening. It will be noted that the successive positions of maximum separation of the lobes are progressively smaller, despite the fact that the trap had recovered completely from its excitatory state, and had presumably re-established its normal rate of growth as is shown at G by the sudden change in slope in the upper phase of each growth curve. The lobes also take longer to recover from the excitatory process after successive closures.

This lack of complete recovery from the repeated daily excitations to closure, as indicated by the decreasing ability of the lobes to attain their original greatest separation, must be due to a change in the elastic modules of the structure or to the inability of certain layers of cells to develop the necessary hydrostatic pressures to displace the lobes to their initial maximum positions. This indicates that as a result of the excitations a more rapid than normal rate of ageing was produced.

How the speed of recovery varies with the intensity of the stimulus supplied by the trigger-hairs is illustrated in figure 5.

Graph A shows the opening motion, after two previous closures, of a trap which had been stimulated by vigorously exciting all six of the trigger-hairs. Graph B shows the opening of the same trap after it had been excited to closure by a critical excitation of a single lower trigger-hair. Note that the recovery of B is more pronounced and much faster, despite its previous three closures. This is indicated by the fact that graph B lies above graph A and that it possesses a larger slope than A. This seemingly contradicts the evidence submitted in figure 4. This inversion of speed of opening is, however, due to the change in intensity of stimulation. Had the trap been as vigorously stimulated to closure in its B as in its A excursion, B would

have fallen below A with a slope less than A. Because the speed of recovery is, however, approximately inversely proportional to the intensity of the stimulus producing closure, it follows that the response to the smaller intensity of the closure stimulus resulted in a faster recovery motion which more than compensated for the normal decreasing sensitivity of the plant.

As more precise data become available, as a result of a more quantitatively reproducible excitation technique, it should be possible to arrive at a more exact relation between intensity of the mechanical stimulus and the speed of recovery. At present, the results are sufficiently reproducible so that the following qualitative deductions can be made.

The greater the intensity of the stimulus, the slower the recovery. If the stimulus is applied to a single lobe to produce closure, then the unexcited lobe moves faster on opening than the excited lobe. Symmetry of opening can only be attained if both lobes are excited at the same time, identical stimulating patterns and intensities being used. Recovery from successive excitations is progressively slower.

Speed of Closure. Lloyd (p. 191) showed in his reproduction of six successive frames of a motion picture study of the vertical aspect of the trap, that closure can take place in less than a half second.

It will be shown that the time to complete the closure of previously unexcited traps, maintained at 25° C, can be controlled by the number and distribution pattern of the trigger-hairs used to initiate the excitatory process leading to closure.

In order to analyze the rapid closure movements in detail, a motion picture camera was used. It had a speed of 16 frames per second, and an exposure time of 1/90 second per frame.

The closing motion of the trap was photographed from two positions. The *vertical aspect* allowed one to follow the decrease in the distance between the margins of the lobes. This reduction in the width of the trap will be referred to as the *linear closure.* In the *horizontal aspect,* the camera was focused on the apex of the midrib, so that the V-shaped distal edges of the lobes were photographed during the closure motion. This horizontal aspect allowed one to analyze the angular motion of the end of the trap. The latter will be referred to as the *angular closure.*

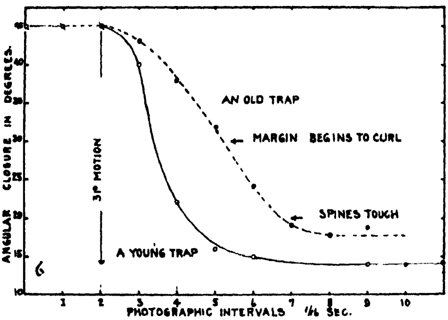
Figure 6 is an analysis of a typical example of a nearly symmetric, high speed angular closure, as recorded at 1/16 second intervals.

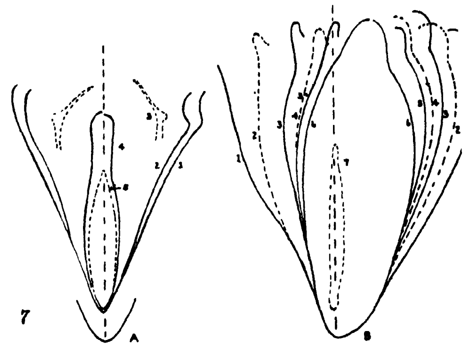
The angular separation of the lobes of the trap, where they converge into the midrib, was measured from the (20 ×) enlarged photographic negatives, to the nearest angular degree.

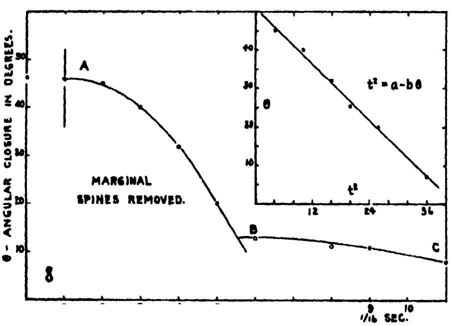
The initial angular separation of the lobes was usually about 45°. The trap was considered closed when four successive frames (4/16 sec.) showed

no variation greater than one degree. This particular closure showed the characteristic response to a mechanical stimulus, described by Lloyd as a "seismonastic movement." It completed its 31° closure in 7/16 second.

The graph shows that the trap begins to close gradually, and gains







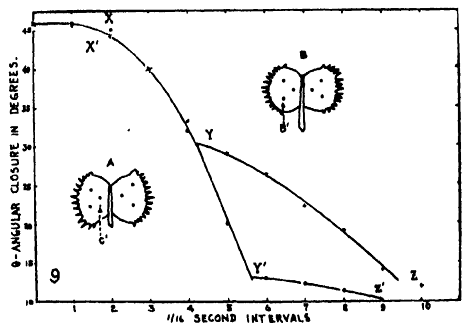


FIG. 6. Angular closure in degrees depicted at $\frac{1}{16}$-second intervals. Basic motion obscured by the presence of interlocking spines. FIG. 7. A. The angular aspect of symmetrical movements of the closing lobes were traced from enlarged photographs spaced $\frac{1}{16}$ seconds apart. Marginal contact is made in position 4. Constriction takes place from 4 to 5 during six $\frac{1}{16}$-second intervals. B. An asymmetrical excited and asymmetrical closure action of a trap in its vertical aspect. Contact of the margins is attained in interval number 6. Delayed action, due to constriction, progressively increased from position 6 to 7. FIG. 8. Basic closure movement develops when marginal spines are removed. Parabolic curve AB regraphed in terms of angular displacement θ and t^2 shows that the decrease in angular separation is directly proportional to the square of the time until contact of the margins takes place at B. BC shows how the free movement AB is decelerated by a retarding factor, contributed by the increasing area of contact of the lobes as they constrict. FIG. 9. Basic motion of the same trap excited to closure in two different ways. XYZ represents motion due to excitation by trigger-hair B′, X′Y′Z′ due to C′. Identical basic motions are produced until ciliated edges touch at Y and Y′. The squeezing action YZ proceeds faster than Y′Z′ due to the asymmetrical approach of the edges of B.

angular velocity as the motion proceeds until the angular opening is reduced about one half, after which it loses speed as a result of a superimposed secondary retarding action. In its initial descent the graph depicts the lobes as decreasing their angular separation as if they were elastically hinged

trap doors. In this first phase of the motion the spinal margins move with a greater angular speed than the lower edges of the lobes, until they make contact. At this point the second phase or squeezing process sets in, shown by the flattening of the central oval aperture. This squeezing action starts at the upper margins, moves down the faces of the lobes until only a narrow oval slit remains. The speed of this squeezing action depends on the degree of excitation.

Figure 7a depicts the composite tracings from the motion picture negatives of the successive positions of the distal edges of the lobes. From this tracing it can be seen that a nearly symmetrical angular closure was produced by critically exciting trigger C on the right lobe. The start of the angular excursion is not so sudden as one is led to expect from visual observation.

In general, the greater the asymmetric position of the stimulus initiating the excitatory process, the less symmetric the final shape of the slit when the closure ceases.

In order to show that the lobes do not leave their rest position with a trigger-like start, but move from this position by building up their velocity in a normal way, the slower closure movements of an older trap is presented in the broken graph in figure 6. In the later phase of the motion the spines introduce a modification in the basic closure motion in the form of an external retarding force. If this external retarding force is removed by clipping these spines, a more basic motion results, simulating the angular closing of a trap door under the action of a constant applied force.

Figure 8 illustrates how a trap, with its marginal spines clipped to eliminate external frictional factors, moves during its third successive closure. The trigger C′ on its left lobe was used as a stimulating center to initiate the excitatory process. It will be noticed that the angular closure movement is unquestionably made up of two fundamental actions, AB and BC. The form of the trace AB shows that the speed is built up gradually at the start. This is indicated by the gradual change in the slope of the curve at A, after which the slope changes rapidly. The whole curve depicts an accelerated motion which suddenly terminated at B when the distal and ventral edges of the lobes came into contact. This phase of the motion was completed in this particular trap, in 9/32 sec.

A parabola of the form $t^2 = a - b\,\theta$ has been plotted through the points of observation. The degree of precision with which the data match the above relation is shown in the insert of figure 8. The curve does not depart from the data by more than four per cent.

The first phase of the closure is a typical dynamical action exhibiting a decrease in angular displacement proportional to the square of the time, i.e.

$-\theta$ *proportional to* t^2. The minus sign indicates that the angular opening is decreasing as the time increases. From this it follows that the increase in angular speed is directly proportional to the time elapsed since the start of the motion, and that the angular acceleration is constant during the motion. This acceleration is attributable to the actions of the restoring forces, inherent in the structural units of the lobes, which come into play when a hydrostatic pressure maintaining the lobes in their distended positions, is suddenly removed.

The first phase AB of the closure is reducible to the classical motion of a rigid body rotating about a vertical axis, under the action of constant normally directed forces. Applying D'Alembert's principle, which asserts that the whole effective forces of a system when reversed are together equivalent to the impressed forces, and taking moments (T) about the midrib as an axis of rotation, we obtain

$$T = \Sigma mr^2 \frac{d^2\theta}{dt^2}$$

where m is the mass of any element of the rotating body, r its distance from the axis and θ the angle which a plane through the axis and the elements makes with the plane of reference.

Hence

$$\frac{d^2\theta}{dt^2} = \frac{\text{moment of forces about axis}}{\text{moment of inertia about axis}}.$$

By integrating we can determine the angle through which such a body has revolved in a given time.

Hence, if F is the resultant of the applied constant normal forces, developed by the frame of the lobe to restore it to its closure position, acting at some point located at a distance r from the axis of rotation, and M is the mass of the lobe, of radius of gyration k, then

$$\frac{d^2\theta}{dt^2} = \frac{-Fr}{Mk^2}.$$

The solution

$$\theta = -\frac{Frt^2}{2Mk^2}$$

shows that the decreasing angular displacement θ is proportional to the square of the time, and is proportional to the applied torque Fr impressed upon the lobe by the stress inherent in the strained frame as a result of its open position.

The second phase of the closure (BC in figure 8) was completed in about 9/16 second, as a squeezing action of the lobes. This is also a parabolic graph, flattened to such an extent that it appears to be linear. It is therefore a continuation of the same phenomena. It represented a slowly decelerating motion with a retardation factor introduced by the continuously increasing

area of contact of the opposing surfaces, which bring the lobes gradually to rest.

That the above motions cannot be simulated by the bending action of a bimetallic strip of metals of different coefficients of expansion with change in temperature, as was proposed by Lloyd (p. 192), is evident when we consider that the latter motion develops a logarithmic deflection in equal increments of time, when the emission or absorption of radiant energy takes place at a constant rate.

This analysis shows why the outer margins of the trap appear to move with such a sudden snap as compared with the creeping motion or squeeze at the middle of the lobe, which completes the closure. The average ratio of these angular speeds is about 8 to 1.

Speed of Closure Depends on Pattern of Excitation. If the inner surface of a lobe composed of certain specialized cells is the seat of the irritable tissue, and if their state of irritability can be assumed to be due to their degree of polarization, then this surface of specialized tissue can, in a steady state, form an interrelated equipotential surface. Its equilibrium must always be attained when the lobes are distended to their maximum position. A localized destruction of the degree of polarization of a single cell in such an equipotential surface must result in a progressive spread of depolarization which could manifest itself as a spreading equipotential electrical wavefront propagated over the surface of the lobe.

Bose (7) identified and measured the speed of such an electrical wavefront in the petiole of mimosa. He found that the velocity of its propagation was of the order of 3.0 cm. per sec.

A sufficient torque applied to one of the trigger-hairs, a form of mechanical stimulus, can destroy the degree of polarization of one or more of the inner sensitive cells at the base of the trigger-hair. This is a localized change in the equipotential field. This must initiate the excitatory process, which in the form of an equipotential wavefront could spread across the inner face of the lobe.

The pattern of the wavefront should be controllable by using different combinations of trigger-hairs as sinks of energy from which a negative equipotential depolarizing wavefront can originate. Such a controlled wavefront should therefore determine the closure movements of the lobes.

Figures 7A and 7B are introduced in order to indicate that the form of the closing motion changes with the position of the trigger-hair used to start the excitatory process. These figures are composite tracings of the successive positions of the distal edges of the lobes, as photographed at 1/16 sec. intervals. In figure 7A the stimulation of the trigger-hair C′ produced nearly symmetric movements of the lobes. In 7B, the left lobe was stimulated

by means of the trigger-hair B′ located near the basal edge facing away from the observer. Note how much faster the left side was moving in the initial phase of the closure than the right side. The squeeze begins as soon as the upper margins make contact and the area of contact increases until a small slot is left between the lobes just above the midrib. On comparing these two slot-like residual separations we note that in the symmetrically excited lobes this opening is symmetrically placed with respect to the midrib. In the asymmetrically excited lobes the residual opening is flatter on the left side, showing how the initial closure movement follows through and continues with its greater speed into the final squeezing motion, leaving the distorted slot as a residual separation. When the motion ceased, equilibrium must have been attained between the stress developed by the closing frame, and the recovering hydrostatic pressures.

In figures 9 is shown an analysis of motions analogous to those depicted in figures 7A and 7B.

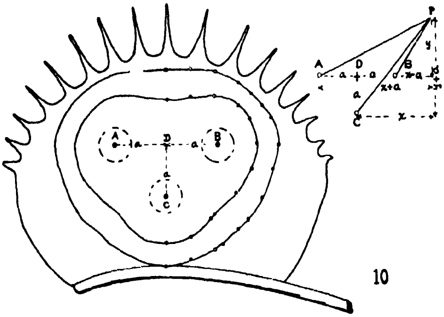
Note that the two graphs represent identical motions up to the points Y and Y′ where the marginal edges make contact, after which they go over into their second closure phase where the angular displacements proceed more slowly. These two closure patterns were obtained from two traps that were about the same age, shape, and size and possessed the same initial angular opening.

Since in X′ Y′ Z′ the excitatory process must spread from the symmetrically located trigger C′ to the margins of the left lobe, and also from C′ across the midrib to the right lobe and thus to its margins, it of necessity follows that the movements of the left lobe should precede those of the right lobe. The movements of the margins are nearly symmetric, so that the initial contact is made by the external edges of the upper margins at about the same time. This contact is represented by the point Y′ which reflects a closure of about 33 angular degrees.

In XYZ the excitatory process spreads from the trigger-hair B′ located near the lower external edge of the left lobe. To reach the right lobe, the excitatory wavefront must also cross the midrib, but since it originates nearer the base of the lobe it follows that these lower edges respond first, hence the distal edges lag. Thus, through an asymmetric spreading of the excitatory wavefront the basal margins of the lobes make contact on closure sooner than if the lobes were symmetrically excited, hence the point Y lies higher on the graph and further to the left on the time axis.

Graph YZ shows that the second phase or the squeeze motion closes the trap 10° in about $\frac{3}{16}$ second while in Y′Z′ the trap moves 10° in $\frac{12}{16}$ second, or a ratio of angular speeds of 4 to 1 in favor of the asymmetrically excited trap. This is due to the fact that the retarding force of the contiguous basal edges is not offering so great a resistance to the motion.

In figure 10 is shown the progressive shape of an ideal equipotential wavefront as if it were moving with constant speed over the inner surface of a lobe. The trigger-hairs A, B, C are placed symmetrically at the corners of



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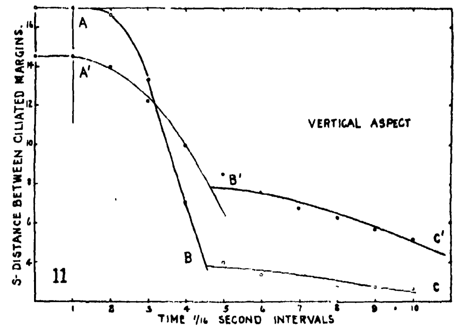

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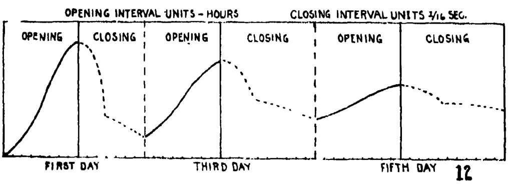

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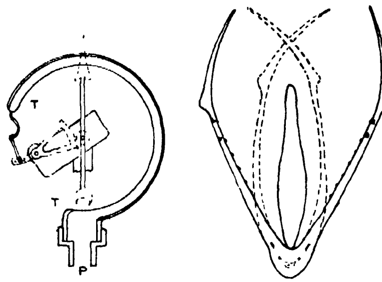

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FIG. 10. Scale drawing of the inner face of a lobe with its three trigger-hairs A, B, and C, symmetrically spaced as indicated. If all three trigger-hairs are excited simultaneously and with identical torques it is assumed that three similar equipotential depolarizing wavefronts arise, identified by the broken circles. These combine to form the equipotential wavefronts after a short interval of time. Its expanded position, after a slightly longer interval of time, is shown as it travels over the lobe, to eventually reach all margins at about the same time. It is found that such a generalized equipotential wavefront can, on theoretical grounds, be the necessary and sufficient reason to account for excitation to produce symmetrical closure. FIG. 11. Measurements of the vertical aspect of closure. The linear distances between the ciliated margins are presented at $\frac{1}{16}$-second intervals. This shows that the linear closure varies with the square of the time, thus proving that this aspect of the basic motion is identical with that shown in figure 7. FIG. 12. Semidiagrammatic history of the opening and closing amplitudes of a single trap excited to closure every twenty-four hours. The openings are expressed in terms of 3-hour units and the closures in $\frac{1}{16}$-second intervals of time. The samples are separated by an interval of 1, 3, and 5 days. At the end of the seventh day the amplitude is inappreciably small and the trap has ceased to respond. FIG. 13. Scale drawing of a precision Bourdon pressure guage. Thin hollow bronze tube T of elliptical cross-section. Closed end attached to a multiplying device which rotates the arrow across a scale of pressure units. An increase in hydrostatic pressure applied at P deflects the closed end upward, a decrease in pressure moves this end down bringing the two ends closer together. The cross-section of *Dionaea* shows the lobes distended under hydrostatic pressure, presumably developed by the layer of cells in the inner epidermis. Broken outline of lobes shows position under decreased hydrostatic pressure. Inner constriction shows upper margins in contact under minimum hydrostatic pressure.

the triangle ABC so that the distances AD = DB = DC = a. If the three trigger-hairs are bent so that they produce equal disturbances of magnitude Q which locally rupture the equipotential surface, then the resultant drop in potential V at some point P (see insert in figure 10) is determined by

$$V = \frac{Q}{AP} + \frac{Q}{CP} + \frac{Q}{BP}$$

Since

$$AP = [(x+a)^2 + y^2]^{\frac{1}{2}};\ CP = [(y+a)^2 + x^2]^{\frac{1}{2}};\ BP = [(x-a)^2 + y^2]^{\frac{1}{2}}$$

it follows that

$$V = Q\{[(x+a)^2 + y^2]^{-\frac{1}{2}} + [(y+a)^2 + x^2]^{-\frac{1}{2}} + [(x-a)^2 + y^2]^{-\frac{1}{2}}\}$$

Since the equation represents the potential at any point in the plane of the lobe, then a wavefront of constant potential C, initiated by an excitatory quantity Q of unit magnitude, is given by

$$C = [(x+a)^2 + y^2]^{-\frac{1}{2}} + [(y+a)^2 + x^2]^{-\frac{1}{2}} + [(x-a)^2 + y^2]^{-\frac{1}{2}}$$

Assigning specific values to C and solving for the coordinates x and y for a value of a = 2, we obtained the equipotential wavefronts shown in figure 10.

Note that as the original circular equipotential wavefront around each trigger-hair A, B, C spreads, they join to form the clover leaf wavefront, which upon further spreading reaches all edges of the lobe at about the same time. Such a symmetrically spreading excitatory process in each lobe can produce a symmetrical closure response. On the other hand, a point excitation originating at a single trigger-hair develops a circular spreading excitatory wavefront which cannot reach all edges at the same time. This produces an asymmetrical closure of the lobes.

We may therefore conclude from both the experimental and theoretical evidence that the shape of the wavefront of the excitatory process determines the pattern of closure.

Does the Midrib Participate in the Closure Movements? Batalin agreed with Darwin (8) that there was a slight contraction of the upper and an accompanying expansion of the lower faces of the lobes, in both a longitudinal and transverse direction. If these were appreciable changes, one would expect that midrib to show a change in curvature as a result of the strains developed in the attached surfaces.

Since the wavefront of the excitatory process in an asymmetrical closure movement must cross the midrib at an angle, one would expect to detect a twist in the midrib if it participated in the closure movement. If the closing motion of the lobes is symmetrical, then no twist should take place when the excitatory wavefront crosses the midrib. If any appreciable reduction in hydrostatic pressure takes place in the midrib during the passage of the excitatory wavefront across this structure, then a change in curvature of the midrib must take place.

In order to test this hypothesis, two independent methods of observation were resorted to. In the first method, a micrometer microscope was focused on a point on the apex of the midrib. The trap was sprung and the displacement of end of the midrib was measured to the nearest tenth of a millimeter. Movements that were less than 0.1 mm. were classified as *no motion.*

An increase in the radius of curvature of the midrib on closure was recorded as an up movement, a decrease in radius of curvature as a down movement. As a result of twisting motion the up movements should shift the point of observation into the first or second quadrant or the down movement would shift the point of observation into the third or fourth quadrant of the field of view of the microscope.

The evidence conclusively showed no motion in 4 closures, and measurable but not consistent motions in 31 closures. Inconclusive evidence from a large number of closures was primarily due to the unavoidable displacement of the microscope image when too much force was used to bend a trigger-hair.

The predominant evidence points to a motion producing an upward twist due to asymmetric excitation, indicating a slight decrease in curvature of the midrib. The composite data indicated that on the average the displacement of the apex of the midrib moved in most cases from 0.2 to 0.4 mm. This conclusion is supported by the photographic records obtained from the angular closure movements which often showed a slight rise in the apex after closure.

In order to get more direct evidence of a change in curvature of the midrib due to closure, it was found necessary to photograph the trap in profile. This evidence was not very conclusive. In the majority of cases the apex of the midrib was slightly raised on closure but the resulting straightening of the rib was not sufficient to warrant a quantitative estimate of the change in curvature. From the observed motions one can only conclude that the midrib reacts to, but does not cause the closure movements.

The Vertical Aspect of Closure. The motion picture records of the vertical aspect of the closure movements were obtained in order to investigate the rate at which the distance between the margins of the lobes decreased. Since the margins swing on an arc of a circle, the photographic record in this aspect of closing only reveals the motion of the chord of the circular motion.

In the tenfold-magnified projected photographic images, the measurements across the width of the open trap were in error of not more than 2mm. in 120 mm., or not more than 2 per cent. The arc described by the margins is about 4 per cent longer than the linear displacements shown in the photographic enlargements. This latter error becomes negligibly small

when one considers the variation in terms of the overall dimensions of the lobes which range from 0.8 to 1.4 cm. in depth.

The basic pattern of the closure curve is shown in figure 11. The lobes approach each other with a rush until the distal and proximal ends of the marginal lips collide, leaving an oval opening covered by the overlapping spines, shown in figure 7. This oval aperture then begins to constrict until contact is made along the whole upper marginal edge. The basic graph therefore depicts two motions, AB the displacement of the margins, the short transition phase at B which degenerates into the squeezing action BC, during which the margins of the oval aperture constrict. These motions are the counterparts of similar actions depicted by the horizontal aspect of the angular closure.

The sudden almost symmetric starting actions and subsequent rapid accelerations are characteristic of the initial closing of all young vigorous, green traps mechanically excited by bending one of the two lower trigger-hairs C or C′ of figure 1.

If the marginal trigger-hairs A, A′ or B, B′ are used to excite closure, the margins approach each other at an angle. If A or A′ is plucked the distal edges of the margins lead. If B or B′ is plucked the proximal edges of the margins lead. If the spines are clipped off at the margins of the lobe, no changes in the basic patterns of closure were observable.

If a trap was cut from its petiole or if the petiole was crushed, no change in the basic closure pattern was produced.

Basic Closure Curve of the Vertical Aspect. In order to resolve the composite motion of the vertical aspect of the basic closure graph, it was necessary to obtain data from a more slowly moving trap. Figure 11 shows how the freely moving margins accelerated from A to B, and came to a sudden stop at B when the outer edges of the margins touched. They then continued to close the oval space left between the marginal lips, with decreasing speed.

The initial phase, the free movement, is represented by the parabolic graph AB. The curve is typical of the motion of a body whose linear displacement is directed proportional to the square of the time. This confirms the results obtained from the analysis of the motion for the angular aspect of closure where the angular displacement was found to be directly proportional to the square of the time. The second phase is also identical to that exhibited by the angular closure.

Lag in Motion. An appreciable time elapsed between the initiation of the stimulus, furnished by a mechanical torque applied to a trigger-hair and the beginning of the motion of the outer margin of the lobe. This lag

in response should be equal to the time taken for the excitatory wavefront to travel from its point of origin, at the base of the trigger-hair, to the margins of the lobes.

If, in a previously unexcited trap, one of the lobes was stimulated to closure by plucking trigger-hairs C or C′, the time that elapsed between the application of the stimulus and the beginning of marginal motion, at 25°C, was as small as 3/16 second, although one trap showed a lag as large as 7/16 second. A comparable lag of from 1/4 to 1/3 of a second was reported by Burdon-Sanderson (9) for the electrical action-current flowing from the proximal to the distal end of the leaf.

In the sensitive plant *Mimosa pudica*, comparable situations have been observed. Detectable "turgor movements" have been reported to occur within 1/13 sec. after stimulation. Thus Bose (7) determined the limiting constant lag to be about 1/10 second, at maximum intensity of stimulus.

Speed of the Wavefront of the Excitatory Process. In the collection of specimens with which this work was done the average distance from an inner trigger-hair C or C′ to the nearest edge of the ciliated margin varied from 0.50 cm. in a small lobe with 1.10 cm. in a large lobe. If in a specific lobe 0.90 cm. was the distance traveled by the excitatory process in 3/16 second from its stimulating point to the ciliated margin, the excitatory wavefront must have traveled with a speed of 4.8 cm. per sec. If the same speed was maintained in crossing the midrib to reach the opposite margin, one should observe the opposite lobe to lag behind the one carrying the seat of the stimulus by from about 3/16 to 4/16 second. This lag was easily recognized in the motion pictures, since the film moved sufficiently fast so that the lag in the response was often recorded on two or more frames.

That an excitatory process having a speed of about 5 cm. per sec. is not excessive can be judged by comparing it to the speed of propagation of the excitation found by Bose (7) for *Mimosa*. At summer temperatures he found that the velocity of transmission of the excitation in the petiole was 3 cm. per sec.

Ageing as Indicated by Speed of Successive Closures. That stimulation of the leaf resulted in a greatly accelerated rate of growth accompanied by a disposition of starch in the cells of the dorsal region soon after closure occurs was reported by Brown (5). Lloyd (1) concluded from his observations that repeated daily responses were followed by decreasing sensitivity, probably due to the completion of growth.

Figure 11 is reintroduced to evaluate the successive increases in closure time as the trap ages. The graphs show two successive closures of the same trap, separated by a rest period of four days. Graph ABC depicts the first

closure as a highly accelerated motion AB in which the lobes were practically brought to rest as a result of the collision between the distal and proximal edges of the ciliated margins. The force was sufficient to bend the margin so that only a small, flattened, oval aperture remained. This oval aperture closed rather slowly, as is apparent from the small slope of the second phase or squeezing action BC. The flexibility of the structure is therefore quite large while the leaf is still young.

The second closure, as analyzed by the graph A′ B′ C′ occurred four days later. Note that the lobes starting at A′ are closer together than they were at A. They move with a slower speed as indicated by the smaller slope of the graph A′ B′. The overall time to complete the first closure of the trap was 13/16 second, while the second closure was completed in 15/16 second. On contact of the distal and proximal edges, the oval aperture was much larger, hence they collided with less momentum.

The velocity of withdrawal of the active force per unit area which maintains the lobes in their distended positions is therefore slower. This active force per unit area must take the form of an internal hydrostatic pressure.

The withdrawal of the fluid in the epidermal cells which lowers the hydrostatic pressure must therefore have taken place much more slowly in A′ B′ C′, since the resulting movements were slower. Ageing therefore affects the speed with which the specialized cells in the inner epidermis can lose their fluids, in order to lower the effective hydrostatic pressure sufficiently to produce mechanical closure.

In order to illustrate the generalized successive motions of the trap of *Dionaea*, in the form of an expected degenerating cycle, attributable to ageing, I present figure 12 as a semidiagrammatic summary of the successive opening and closing phenomena in time.

The composite motions of the expanding lobes are shown in terms of hourly units, and the successive closures in 1/16 sec. units of time. The cyclic process shows the initially rapid opening and closing motions following each other in successive longer periods of time and with successive smaller amplitudes proportional to the recovered separations of the lobes, until the reactions to the applied stimulus cease. Since not more than four successive events were ever successfully analyzed for any given trap, no quantitative evaluation of the decrement was obtained.

Opening Movements and Closure Attributable to Hydrostatic Pressure Changes. In seeking for a stress that must be removed to produce closure in response to stimulation, we join with the earlier investigators in attributing the collapse of the lobes to a rapid reduction in the turgor of specific cells.

Ashida (3) concluded from his work on the leaf movements of *Aldrovanda vesiculosa* that the motions in this form of trap were attributable to the changes in turgor of the inner epidermis. This same conclusion was independently arrived at, for *Dionaea*, by Burdon-Sanderson. Since there is a definite analogy between the structure and movements of the traps of *Aldrovanda* and *Dionaea*, one may be permitted to start from the premise that the movements of the lobes in both forms of trap are due to changes in turgor of the inner epidermis, and that the central layers of parenchyma cells with their sustaining framework reflect the elastic properties of the mechanism.

It is proposed to offer some additional support to the theory that changes in the hydrostatic pressures developed by the inner epidermis are the necessary and sufficient conditions to produce the recorded motions in *Dionaea*.

The present data exclude the possibility that the movements of recovery are primarily due to the growth of the inner epidermis.

In order to account for the mechanical opening movements on fundamental hydrostatic principles, it is necessary that the cells of the inner epidermis be longer in the direction perpendicular to the midrib than those in the outer epidermis. Since an increase in their hydrostatic pressure expands these cells in all directions, they must in addition tend to straighten themselves in the direction perpendicular to the midrib in order to account for the mechanical separation of the lobes. They should therefore mechanically conform to the same fundamental principles incorporated in the design of the sensitive pressure element in the Bourdon pressure gauge, where an increase in hydrostatic pressure straightens its functional pressure element.

The similarity in hydrostatic response and mechanical structure is strikingly apparent when we compare the sensitive tube-mechanism actuating the Bourdon gauge with the structual elements of a cross section of a lobe taken perpendicular to the midrib, as illustrated by figure 13.

The Bourdon Pressure Gauge. It is an established fact that thin-walled curved tubes possessing elliptical cross sections are very sensitive to bending flexure. The angular deflection of such a curved hollow tube, in the process of straightening, is both on theoretical grounds (Lorenz, 10), and from experience, directly proportional to the increase in the applied internal hydrostatic pressure. The Bourdon gauge (figure 13) is a mechanical device which uses this principle for measuring hydrostatic pressures. It is essentially nothing but an elliptically flattened metal tube, curled into an arc of a circle with the longer axis of its elliptical section perpendicular to the general plane of the tube. This tube is closed at its upper end. As a gradually

increasing hydrostatic pressure is applied at its lower open end, the curved tube straightens. The straightening or decrease in curvature is accompanied by a decrease in the ellipticity of its cross section. As the pressure rises the elliptical cross section gradually approaches, in the limit, a circular form because a circular form contains the largest area for a given perimeter.

In this process of straightening of the curved tube subjected to a gradual increase in internal hydrostatic pressure, the tensile forces of the fibers in the convex side and the compressive forces of the fibers in the concave side have internally directed resultant forces that can gradually be neutralized by increasing hydrostatic forces directed normal to the inner surfaces of the tube. The minor axis of the elliptic section therefore increases until the cross section approaches a circular form, at which point the straightening process of the tube ceases.

A decrease in sensitivity is obtained by either increasing the thickness of the tube or increasing its modulus of elasticity.

To make the gauge structure more sensitive to small changes in internal hydrostatic pressures, Lord Rayleigh suggested that one must replace the two uniform halves of the elliptical tube, which lie on either side of its major axis, by two symmetric curved sections which meet on the major axis at a finite angle.

Figure 13 shows a cross section of the lobes of *Dionaea*. The elongated large-celled middle layer (Lloyd, *plate 18, fig. 18*) of each half of the U-shaped structure can be considered as forming a narrow hollow element fulfilling the mechanical requirements of a very sensitive Bourdon gauge. Two of these elements are considered as joined at the base to form the midrib section.

If the inner cells of this section are now considered partly filled with a liquid, a gradual increase in their hydrostatic pressure will straighten and hence spread the closed lobes. This duplicates the action of a Bourdon gauge due to an increase in its internal hydrostatic pressure.

If the motion of the lobes is attributed to the tendency of the diffusion pressure deficits of the inner cells to attain a steady state these must therefore possess the necessary and sufficient attributes to function as elongated circular or quasi-elliptical structures whose longitudinal axes must straighten as their hydrostatic pressures rise,. to counteract the stresses of the normally bent framework of the lobes when closed.

Conversely a decrease of the hydrostatic pressure will reduce the effective normally directed internal forces so that the opposing elastic forces of the fibers in the supporting frame predominate. These curl the frame back into its original configuration.

If the hydrostatic pressure in the Bourdon gauge is reduced rapidly enough the gauge snaps back into its curved position with great speed.

This stimulates the first phase of the closure movements of *Dionaea*. It is, however, impossible to release the hydrostatic pressure of osmotically functioning cells with sufficient rapidity to account for the speed of closure. Hence the cause of the rapid release of the internal pressure must be attributed to a structural change in the interfaces of some cells so as to produce the necessary rapid turgor pressure changes.

A sudden depolarization of the inner specialized layer of epidermal cells with the accomanying change in the hydrostatic pressure which maintains the lobes in their distended positions could be a necessary and sufficient mechanism to account for the closure movements.

It is hoped that the plant physiologist can establish that such an actuated irritable tissue mechanism exists, which allows the inner epidermal cells to drain their fluids into the neighboring intercellular spaces so as to establish the necessary hydrostatic gradient to fulfill the underlying mechanical principles involved in the motions of the lobes of *Dionaea.*

The author takes this opportunity to express his appreciation to Dr. L. A. Whitford, Department of Botany of the North Carolina State College of Agriculture and Engineering at Raleigh, for supplying many beautiful specimens, photographs, and sections of *Dionaca,* and to J. Stanley Johnson for assistance in the calculations of the equipotential fields.

SUMMARY

When the trap of *Dionaea muscipula* had been excited to closure, the recovery or opening movements are independent of the normal processes producing movements of the lobes due to growth. At constant temperature the change in the intensity of light did not affect the basic recovery motion. Frictional factors introduced by the presence of occasional interlocking marginal spines was avoided by clipping away the spines near their bases. Opening speeds of individual lobes are controllable. The lobe which is excited to produce closure does not recover so rapidly as the unexcited lobe. Symmetric opening can only be attained if symmetric closure movements preceded the recovery movements. Speeds of recovery from repeated closures decrease, depending on degree and order of excitation and the trigger-hair pattern that was used to stimulate the excitatory process producing closure.

Closure was analyzed with a moving-picture camera at a speed of 16 frames per second. Angular closure and the vertical aspect of the closing of the edges of the trap showed that the decrease in angular separation and the linear distance between the margins of the lobes were directly proportional to the square of the time. The basic movements are representable by the classical motion of a rigid body rotating about a vertical axis under

the action of constant normally directed forces. The forces maintaining the trap in its open or distended position can be attributed to the action of an internal hydrostatic pressure localized in the layers of cells forming the inner epidermis.

Speed and symmetry of closure can be controlled by the pattern of excitation used to stimulate. A hypothetical excitatory wavefront is derived to show how its action could account for the pattern and speeds of closure. The spreading speed of the excitatory process was determined as about 5 cm. per sec. in young, green plants. As the leaves age the speed of successive closures decrease and recovery is never a completely reversible phenomenon. A hydrostatic analogue in the form of the response mechanism of the Bourdon gauge, is proposed as possessing the necessary and sufficient properties to account for all the mechanical motions. It is suggested that a depolarization of the interfaces of the hydrostatic cells of the inner epidermis can account, on physical grounds, for this sudden reduction in hydrostatic pressure which allows the lobes to collapse as if they were trap doors connected by a flexible hinge swinging under the action of a constant torque.

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Literature Cited

1. **Lloyd, F. E.** The carnivorous plants. Chronica Botanica Company. Waltham, Mass., 1942.
2. **Solereder, H.** Systematische Anatomie der Dicotyledonen. Stuttgart, 1899.
3. **Ashida, J.** Studies on the leaf movement of *Aldrovanda vesiculosa*. Mem. Coll. Sci. Kyoto Imp. Univ. B. **9**: 141–244, 1934; **11**: 55–113. 1935. Bot. Mag. Tokoyo **51**: 505–513. 1937.
4. **Batalin, A.** Mechanik der Bewegung der insectenfressenden Pflanzen. Flora **60**: 33–39; 54–58; 105–111; 129–154. 1877.
5. **Brown, W. H.** The mechanism of movement and the duration of the effect of stimulation on the leaves of *Dionaea*. Am. Jour. Bot. **3**: 68–90. 1916.
6. **Munk, H.** Die electrischen und Bewegungserscheinungen am Blatte der *Dionaea muscipula*. Arch. Anat., Physiol. Wiss. Med. **1876**: 30–203.
7. **Bose, J. C.** An automatic method for the investigation of transmission of excitation in *Mimosa*. Phil. Trans. Roy. Soc. B. **204**: 63–97. 1914.
8. **Darwin, C.** Insectivorous plants. London, 1875.
9. **Burdon-Sanderson, J.** Note on the electrical phenomena which accompany stimulation of the leaf of *Dionaea miscipula*. Proc. Roy. Soc. **21**: 495–496. 1873.
10. **Lorenz, H.** Theorie der Röhrenfedermanometer. Zeits. Ver. Deuts. Ing. **54**: 1865–1867. 1910.

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THE GROWTH-PROMOTING ACTION OF BACTERIA-FREE CROWN-GALL TUMOR TISSUE[1]

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Production of plant hormones in galls generated by *Phytomonas tumefaciens* has been reported by several workers (Link, Wilcox & Link 1937; Locke, Riker & Duggar 1937, 1938, 1939; Riker, Henry & Duggar 1941). Locke, Riker and Duggar (1938) discovered five types of response shown by plants inoculated with *Ph. tumefaciens*, all of which might be attributed to the formation of growth substances in the galls. These reactions were epinasty of leaf petioles, initiation of adventitious roots, stimulation of cambium, inhibition of growth of lateral buds, and delay of petiole abscission. Subsequent study substantially confirmed these results (de Ropp 1947e) and showed that, when tumor tissue is grafted to normal stem tissue, a type of proliferation frequently results resembling that induced by high concentration of indole acetic acid. The experiments here described were undertaken to throw more light on the nature of the substance producing these effects.

Materials and Methods. Stem tissue of *Helianthus annuus L.* which had been rendered sterile by removal of the epidermis was used as the test object in these experiments. The mode of preparation of this tissue has been previously described (de Ropp 1947b). It was hoped that, by using normal stem tissue as a test object, effects might be observed which would not be detectable by the use of such test objects as the *Avena* coleoptile. The strains of tumor tissue used in this work had the following origins: H_{13}, sunflower tumor tissue isolated from a secondary tumor in 1941 (White & Braun 1942), P_I and P_{II} sunflower tumor tissue isolated from primary tumors of sunflower (de Ropp 1947d), K_I sunflower tumor isolated from an induced tumor in an *in vitro* graft (de Ropp 1947e), V_{60} periwinkle tissue isolated from a gall on *Vinca rosea* which had been freed of bacteria by heat treatment (Braun 1943, White 1945).

An estimate of the weight of the normal stem fragments at the beginning of the experiment was obtained by taking a sample of the stem fragments at random, weighing, and calculating the means. After treatment with the material to be tested, the stem fragments were cultured on standard nutrient

[1] This work was done in part under an American Cancer Society grant recommended by the National Research Council Committee on Growth.

[2] I am indebted to Miss E. Pieczur for technical assistance in connection with this work.

agar at a temperature of 25° C in continuous light provided by fluorescent lighting units. At the end of this period, the fragments were removed and the individual fresh weights and collective dry weights of the fragments in each group were estimated. Each treatment usually contained 20 replicates. The variability of response of the stem fragments was found to be very large and for this reason the fresh weights have been partitioned between different weight classes and the significance of differences determined by use of the chi squared test.

Results. (a) *Direct Grafting.* Tumor tissue of strains H_{13}, P_I, P_{II}, K_I was grafted onto sunflower stem fragments. Normal sunflower stem tissue was similarly grafted as a control. At the end of the four-week growing period the grafts which had taken were removed from the culture tubes and the scion was separated from the normal stock. These stocks were then weighed. The frequency distribution of the fresh weights is shown in table 1.

TABLE 1. *Effect of grafting to normal or tumor tissue on the fresh weights of sunflower stem fragments grown on nutrient agar for four weeks at 25° C.*

Scion	Weight class (mg.)						
	0–50	50–100	100–150	150–200	200–250	250–300	Total
Ungrafted	4	16	0	0	0	0	20
Normal	5	10	0	0	0	0	15
H_{13}	0	6	6	3	0	0	15
P_I	0	2	6	3	3	2	16
P_{II}	0	3	3	2	0	0	8
K_I	0	4	5	0	6	4	19

There is no significant difference in frequency distribution between the stem fragments to which the scion of normal stem tissue was grafted and those stocks which were left ungrafted. From this it appears that no growth-promoting factor passed from the scion into the stock. Those stocks to which tumor tissue was grafted, however, had weights the frequency distribution of which differed in a highly significant manner from that of the stocks grafted to normal tissue. On 17 of the 19 grafts made with strain K_I, secondary tumors were observed at the point of junction of stock and scion. These tumors were removed before the weights were assessed. The presence of the tumor scion also had a significant effect on root production in these grafts. Root production occurred on all the stocks grafted to tumor tissue but only on three of twenty in the ungrafted group and four of fifteen in the group grafted to normal tissue. This experiment, therefore, confirms previous findings and shows that, when normal tissue is grafted to tumor tissue, a factor passes from the tumor scion into the normal stock capable of enhancing growth in the normal tissue which results in a significant increase in the weight of the latter. When normal tissue was used as the scion, no such effect was observed.

(b) *Separation of Normal and Tumor Tissue by Agar Block.* These experiments were designed to determine whether any growth-promoting factor present in tumor tissue was capable of diffusing through a block of agar and of influencing the growth of a fragment of normal sunflower stem placed in contact with the opposite face of the agar. Blocks of sterile 1% agar were prepared by pouring the agar into a petri dish to give a layer of agar of approximately 4 mm. in thickness. Blocks of this agar about 5 mm. square were removed aseptically and placed upright on the surface of slopes of nutrient agar. In contact with one surface of the agar block was placed the cut surface of a fragment of tumor tissue. On the opposite side of the block was placed the cut end of a fragment of normal tissue. Tumor and normal tissue were thus separated by a 4 mm. thickness of agar. In the control group normal sunflower stem tissue was used in place of tumor tissue. The preparations were incubated for a period of 4 weeks at the end of which time the normal tissue was removed and weighed. The frequency distribution of these weights is shown in table 2.

TABLE 2. *Fresh weights of normal stem fragments separated from tumor tissue by agar block after four weeks' culture at 25° C.*

Treatment	Weight class (mg.)					
	50–60	60–70	70–80	80–90	90–100	Over 100
Agar only	5	3	0	0	1	2
Normal tissue	0	1	4	4	5	1
P_I	1	2	4	3	3	5
P'_{II}	2	3	6	3	1	1
H_{13}	2	2	4	1	1	1

To determine the significance of differences observed in this table, the values for weights of stem tissue grown in the presence and absence of tumor tissue can be summed to give the following 2 × 6 contingency table.

Treatment	Weight class (mg.)						
	50–60	60–70	70–80	80–90	90–100	Over 100	Total
Tumor tissue absent	5	4	4	4	6	3	26
Tumor tissue present	5	7	14	7	5	7	45
Total	10	11	18	11	11	10	71

The value of χ^2 as calculated from this table is 4.09121 which corresponds to a value for P of approximately 0.5 for 5 degrees of freedom. This indicates that the tumor tissue when separated from normal tissue by a block of agar

exerts no significant effect on the growth of the normal tissue. The growth-promoting factor, the existence of which was demonstrated in the previous section, does not appear to possess the capacity to diffuse through agar.

(c) *Extracts of Tumor Tissue.* These experiments were designed to test the effect of adding extracts of tumor tissue to the medium on which fragments of normal stem tissue were grown. In the first experiment of this group, the juice of tumor tissue of strains P_1, K_1, H_{13} and V_{60} was expressed aseptically. This juice was dropped in 0.5 ml. amounts onto fragments of sunflower stem tissue on nutrient agar. As a result of the treatment, the fragment itself was covered with the juice of tumor tissue and the agar in the vicinity of the fragment saturated with it. As a control juice was expressed from normal sunflower stem tissue which had been rendered sterile by the removal of the epidermis. The juice was applied to the stem fragments to be tested in the same way as the tumor tissue extract. After 4 weeks of growth under these conditions, the stem fragments were removed and their fresh weights determined. The frequency distribution of these weights is shown in table 3.

TABLE 3. *Distribution of fresh weights of stem fragments cultured for four weeks in the presence of extracts of normal and tumor tissue.*

Treatment	Weight class (mg.)						
	30–40	40–50	50–60	60–70	70–80	80–90	Over 90
No extract	2	5	2	3	4	1	3
Normal tissue	0	6	2	2	3	3	2
P_1	1	4	0	3	4	2	5
K_1	2	2	5	4	3	1	2
V_{60}	1	5	3	1	7	1	1
H_{13}	1	5	4	5	2	0	3

This distribution may be simplified by summing frequencies in the group treated with tumor tissue extract and those treated with normal tissue or left untreated. This gives the following 2 × 7 contingency table.

	Weight class (mg.)							
	30–40	40–50	50–60	60–70	70–80	80–90	Over 90	Totals
Tumor extract absent	2	11	4	5	7	4	5	38
Tumor extract present	5	16	12	13	16	4	11	78
Totals	7	27	16	18	23	8	16	115

This table gives a value for χ^2 of 3.7144 which with 6 degrees of freedom corresponds to P = 0.7. This shows that the extracts of tumor tissue were

without any significant effect on the growth of the fragments of normal stem tissue.

With a view to preventing enzymatic reactions within these extracts, further experiments were performed in the first of which the tumor tissue was heated to the temperature of boiling water for one minute before being ground and in the second the extract was similarly heated immediately after being ground. The summarized data of these experiments is shown in table 4.

TABLE 4. *Distribution of fresh weights of stem cultures treated with heated extracts of tumor tissue after four weeks' culture at 25° C.*

	Weight class (mg.)							
	30–40	40–50	50–60	60–70	70–80	80–90	Over 90	Total
Tumor extract present	4	3	5	11	5	3	3	34
Tumor extract absent	4	12	13	13	5	4	5	56
Totals	8	15	18	24	10	7	8	90

This gives a value for χ^2 of 4.6678 corresponding to a probability of about 0.6 which shows that the heat treatment of the extracts did not alter their effect on the growth of these fragments.

SUMMARY AND CONCLUSIONS

Evidence that crown galls give rise to growth-promoting substances capable of causing epinasty of petioles and initiation of roots has been established beyond reasonable doubt (Locke, Riker & Duggar 1938; de Ropp 1947a). The data in this paper indicate that a factor capable of inducing growth in excised fragments of sunflower stem tissue will pass from tumor to normal tissue, provided that the two are grafted together. But whatever the nature of this factor it appears that it does not diffuse into agar, nor is it present in an active form in extracts of tumor tissue prepared in the fashion described above. The nature of the growth substance of crown-gall tissue thus still remains undetermined.

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Literature Cited

Braun, A. C. 1943. Studies on tumor inception in the crown-gall disease. Am. Jour. Bot. **30**: 674–677.

De Ropp, R. S. 1947a. The response of normal plant tissues and of crown-gall tumor tissues to synthetic growth hormones. Am. Jour. Bot. **34**: 53–62.

————. 1947b. Sunflower stem cultures for the detection of plant hormones. Nature **159**: 606.

————. 1947c. The growth promoting and tumefacient factors of bacteria-free crown-gall tumor tissue. Am. Jour. Bot. **34**: 248–261.

——————. 1947d. The isolation and behavior of bacteria-free crown-gall tissue from primary galls of *Helianthus annuus*. Phytopathology **37**: 201–206.

Link, G. K. K., Wilcox, H. W. & Link, A. D. 1937. Responses of bean and tomato to *Phytomonas tumefaciens, P. tumefaciens* extracts, B-indoleacetic acid, and wounding. Bot. Gaz. **98**: 816–867.

Locke, S. B., Riker, A. J. & Duggar, B. M. 1937. A growth hormone in the development of crown-gall. Phytopathology **27**: 134. (Abstract.)

——————, —————— & ——————. 1938. Growth substance and the development of crown-gall. Jour. Agr. Res. **57**: 21–39.

——————, —————— & ——————. 1939. The nature of growth substance originating in crown-gall tissue. Jour. Agr. Res. **59**: 535–539.

Riker, A. J., Henry B. & Duggar, B. M. 1941. Growth substance in crown-gall as related to time after inoculation, cortical temperature, and diffusion. Jour. Agr. Res. **63**: 395–405.

White, P. R. 1945. Metastatic (graft) tumors of bacteria-free crown-galls on *Vinca rosea*. Am. Jour. Bot. **32**: 237–241.

White, P. R. & Braun, A. C. 1942. A cancerous neoplasm of plants. Autonomous bacteria-free crown-gall tissue. 1942 Cancer Research **2**: 597–617.

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THE ORIGIN OF TOBACCOS OF THE ORIENTAL TYPE[1]

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Introduction. Throughout our studies of oriental tobaccos during the past eight years we have frequently been asked "What is the original source from which the oriental or Turkish types of tobacco were derived?" It is commonly accepted that all species of *Nicotiana* are of American origin, with the exception of *N. suàveolens* and perhaps a few others that are native to Australia. It also seems well established that tobacco was not mentioned from Europe or Asia until after the discovery of America by Columbus (Garner 1946).

The striking differences between flue-cured, cigar-leaf, Burley, dark-fired, and oriental tobaccos, and also varietal differences within each of these types as they are grown in the field, give rise to some skepticism as to their common origin. If it could be observed that certain oriental varieties and domestic varieties may be grown under conditions in which they come to resemble each other so closely as to be difficultly distinguishable, then the evidence of the same origin of these types would be accepted. During the past season such evidence has indeed been brought to the attention of certain tobacconists, who have expressed their complete accord with the conclusions and interpretations given in the brief considerations that follow.

Materials. Seed of approximately 50 named varieties of oriental tobacco, originating in Greece, Turkey, and Iran, were provided for experimental use during the season of 1947. In early May seedlings of each variety were transplanted into a field at the Tobacco Experiment Station, Oxford, N. C., the plants being spaced 5 inches apart in 20-inch rows. Also in an adjacent plot certain of these varieties were spaced so that the interval between plants was 24 inches in 4-foot rows. Other cultural conditions were quite alike with both spacings. Three of the varieties thus grown bore the varietal names Mavros de Lamia, Argos, and Sari de Almyros. Attention is especially directed to these three varieties because they appear to represent three widely different domestic types, namely flue-cured tobacco, cigar-leaf tobacco, and Burley tobacco respectively.

Observations. It is quite generally appreciated by growers that spacing influences the stature of the tobacco plant. When plants are grown closely

[1] These investigations were financed, in part, by the General Education Board. The cultivation of oriental tobacco is being studied cooperatively by the Department of Botany and the Department of Chemistry, Duke University, and the North Carolina State Department of Agriculture. Grateful acknowledgment is made for the whole-hearted cooperation of E. G. Moss, Tobacco Experiment Station, Oxford, N. C.

spaced, the outcome is decreased size, maximum size being reached only when ample distance between plants is provided. Little is known, however, about the dissimilarities induced by spacing other than the fact that physical differences or gross morphologic differences are produced. In the present observations with the above-mentioned varieties such differences are portrayed by measurements of plant and leaf size, as shown in table 1.

It is plainly evident from table 1 that each variety responded by production of plants having larger stature and larger leaf sizes at the larger interval of spacing. Proportion or balance between stem dimensions and leaf dimensions of each variety, although not directly shown, was apparently maintained. Supportive evidence for this conclusion, as regards the leaves, is shown photographically in figures 1, 2, and 3, representing Mavros de Lamia, Argos, and Sari de Almyros, respectively.

TABLE 1. *Comparison of gross features of certain oriental varieties of tobacco when grown at different spacing intervals.*

Variety	Height of plants (cm.)		Average leaf area of plants (cm.^{2})		Leaf length × leaf width of plants (cm.)	
	Closely spaced	Widely spaced	Closely spaced	Widely spaced	Closely spaced	Widely spaced
Mavros (black or dark) de Lamia	45	120	144	562	23 × 8	46 × 16
Argos	56	140	167	1042	22 × 12	46 × 28
Sari (yellow) de Almyros	55	100	160	475	16 × 7	34 × 18

From these data and photographs it remains difficult, however, to visualize the similarities and differences that meet the eye when these varieties are seen in the field. For example, to anyone familiar with domestic types of tobacco, Sari de Almyros is undoubtedly the well known variety, White Burley, whether it is seen in the seedbed, or whether observed in closely spaced rows or in widely spaced rows in the field. Furthermore Mavros de Lamia is one of the well known flue-cured varieties known as Lizard's Tail, that formerly was rather widely grown in Virginia. It may be readily identified when grown in widely spaced rows. Argos, on the other hand, is some cigar-leaf variety. We are unable however, to identify Argos among named domestic varieties of cigar-leaf tobacco, because of lack of familiarity with them. It is of more than passing interest to relate that our opinion of the identity of this variety is supported by the experience of a dealer[2] who offered a quantity of Argos grown in Macedonia to several manufacturers of blended cigarettes. These manufacturers refused the tobacco for the

[2] Private communication.

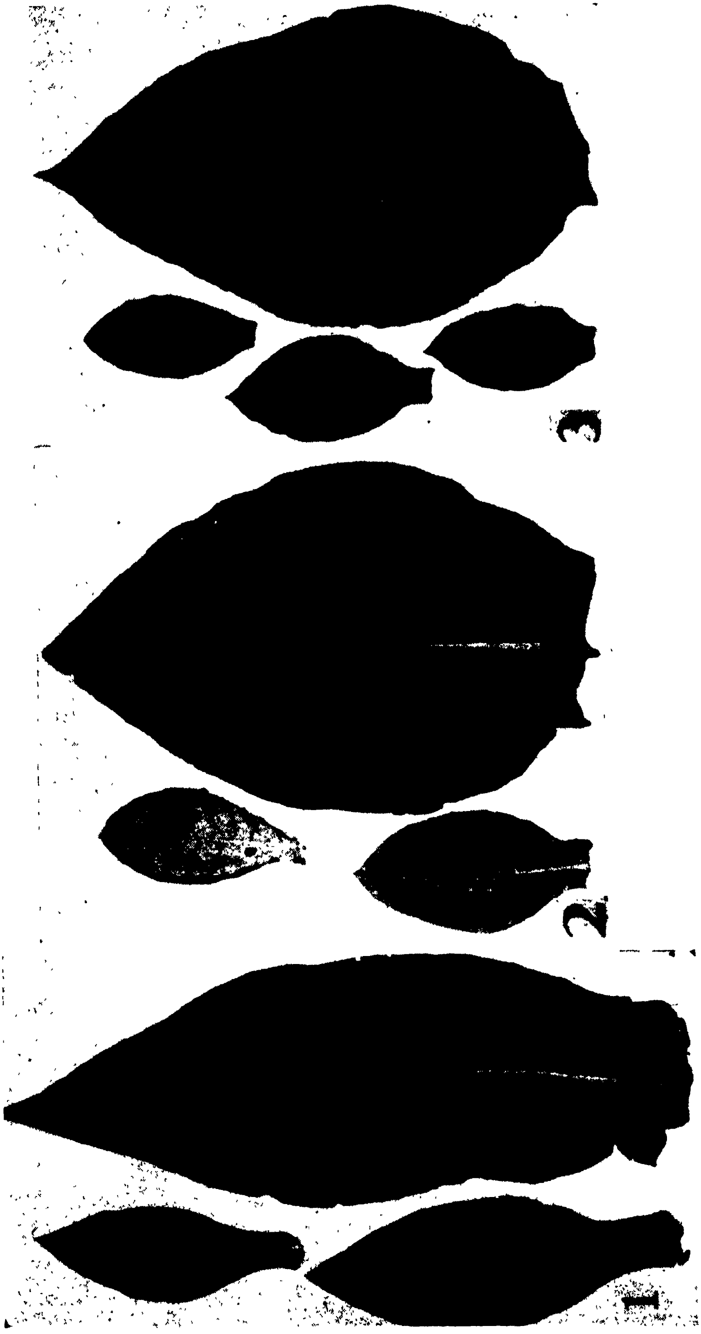

FIG. 1. At left, two average sized leaves of Mavros de Lamia (Lizard's Tail) tobacco, at right, a leaf that is typical of Lizard's Tail, a flue-cured variety. Note comparative sizes. FIG. 2. Appearance of Argos. At left, 2 typical leaves when grown as an oriental tobacco, at right, a leaf when grown as a cigar-leaf type. The sizes are comparative. FIG. 3. Appearance of oriental Sari de Almyros (White Burley) when grown as an oriental tobacco, at left, and when grown as a Burley type, at right.

reason that they regarded it as unsuitable for blending purposes. The tobacco was however accepted for use by a cigar manufacturer.

Discussion. As is generally known, genetical studies bearing on the origin of ordinary tobacco and of other species of *Nicotiana* have been made in recent years at the University of California. The results of certain of these studies (Setchell, Goodspeed & Clausen 1922; Goodspeed 1933) indicate that ordinary tobacco may well be a natural hybrid, resulting from a cross between *Nicotiana sylvestris* and some member of the *N. tomentosa* group. If *N. tabacum* is a hybrid, then a basis exists for the seemingly endless variety of forms of which it is composed, as evidenced by the different domestic type groups, each containing a multiplicity of different varieties having differences in stature, in leafiness, in size, shape, color, and texture of leaves, in color of flowers, in date of flowering, and in other features.

There is little accord among those who have attempted to classify varieties of *Nicotiana tabacum*. Among the early students of this problem is Comes (1899) who recognized six primary varieties, the differences between them being based upon shape of leaf and character of corolla. He designated them by the varietal epithets *brasiliensis, fruticosa, havanensis, lancifolia, macrophylla,* and *virginica*. Geneticists have experienced no difficulty in crossing these varieties, and furthermore ordinary tobacco has been crossed with each of approximately a score of other species of *Nicotiana* (Goodspeed 1933). The subject of intervarietal and interspecific hybridization of tobacco is succinctly considered by Garner (1946) in a recent volume *The Production of Tobacco* and hence will not be further discussed.

It is now impossible to determine when any one of the three varieties under consideration herein was first grown in the countries bordering the Mediterranean Sea. As indicated by Garner (1946) White Burley (Sari de Almyros) presumably originated as a mutant in Ohio in 1864. Lizard's Tail (Mavros de Lamia) has been largely supplanted as a commercial flue-cured variety in Virginia but it is still cultivated in some sections. It seems quite probable therefore that both of these varieties were introduced into the Near East since the turn of the century. Similarly Argos must have been introduced there recently. At any rate none of them possesses the characteristics of a good-quality oriental tobacco and none has been changed appreciably in response to the environment of the Mediterranean region.

Quite a different situation obtains, however, as regards the oldest, best known, and best established kinds of oriental tobacco now being extensively cultivated in the Near East and constituting the bulk of the product being exported. These varieties do not resemble, to any significant degree, any of the varieties of any domestic types now being cultivated in the United States. It should be recalled, in accounting for this lack of resemblances, that tobacco was introduced into Turkey and Iran during the early part of the 17th

century. During this period of approximately 300 years many changes in characteristics could have been wrought in the Near East, and it is quite certain that present day kinds under cultivation in the United States are unlike those grown by the early settlers. The differences between oriental types and domestic types are such as might result from hybridization, selection, and environmental factors operating over a maximum period in excess of 300 years in each region or perhaps a totality of 600 years in either region alone. This conclusion, as regards oriental tobaccos, accords with Nestoroff (1928) who stated that their origin is now quite completely lost and they must be placed in a class by themselves. All evidence indicated to him that the original kinds came from America but many new kinds having features that are fundamentally different from the original kinds had come into existence as the result of many crosses and of adaptative changes.

Summary

Seed originating from certain varieties of oriental tobacco in the Mediterranean region, when planted and grown in the United States, produce kinds that are recognizable as identical with domestic varieties at present being cultivated in this country. A representative variety of each of three domestic types has been thus recognized. Each one was apparently introduced from the United States into the Near East in recent years. These results constitute evidence that oriental tobaccos originated in the Americas and that means are still at hand to prove their origin.

Varieties that cannot be identified with kinds now being cultivated in tobacco-growing regions of the United States may be presumed to have become greatly modified in response to hereditary and environmental factors that have acted throughout the long period from their early introduction in the Near East.

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Literature Cited

Comes, O. 1899. Monographie du genre *Nicotiana* comprenant le classement botanique des tabacs industriels. Atti R. Inst. Incoraggiamento Napoli V. 1. 80 p.

Garner, W. W. 1946. The production of tobacco. XIII + 516. Philadelphia.

Goodspeed, T. H. 1933. Chromosome number and morphology in *Nicotiana*. Proc. Nat. Acad. **19**: 649–653.

Nestoroff, Marco. 1928. The oriental tobaccos. Vol. 1, 250 p. Dresden.

Setchell, W. A., Goodspeed, T. H. & Clausen, R. E. 1922. Inheritance in *Nicotiana tabacum*: I. A report on the results of crossing certain varieties. Univ. Calif. Publ. Bot. **5**: 457–582.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 75, NO. 1, pp. 56–115 JANUARY, 1948

PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—I.[1]

BASSETT MAGUIRE AND COLLABORATORS

Since the early journeys and collections of Schomburgk, the Guyana Highland has become increasingly recognized as a region of considerable botanical complexity, diversity, and antiquity. Over a long period, as successive explorations of the lofty dominating sandstone mesas, Roraima, Duida, and Auyantepui progressed, great numbers of new species and genera were uncovered, revealing a vast, hardly touched phytogeographic province where apparent endemism on the isolated block mountains is incredibly high.

More recently, Duida and Roraima have been revisited and the plants of another mountain, Ptari-tepui, collected by Dr. Julian A. Steyermark of the Chicago Natural History Museum (Speciation in the Venezuelan Guyana. Am. Jour. Bot. **34**: supplement 29a. 1947. [Abstract.])

Within the last year still another high plateau, Cerro Yaví, has been explored by William H. Phelps, Jr., who has achieved such spectacular results in the collection and study of the avi-fauna of the numerous sandstone mountains of the Guyana Highland. No one else has carried on scientific exploration in this important region so continuously and successfully as he. A collection of plants made from Cerro Yaví by Mrs. Phelps and Charles B. Hitchcock is now under study in Caracas and New York.

During 1944 the New York Botanical Garden undertook the exploration of the most eastern and farthest isolated of the block mountains, Tafelberg, in central Surinam, lying at the headwaters of the Saramacca and Coppenam Rivers. Tafelberg, although perhaps seen by early explorers, was discovered,[2] recognized in its true significance, and visited in 1926 by Professor Gerold Stahel, eminent botanist and agriculturist of Dutch Guiana.

To better interpret the flora of Tafelberg and to correlate it with that of the Guyana Highland far to the West, a short period of study and collection was spent on the Kaieteur Plateau by D. B. Fanshawe, forest officer in British Guiana, and me.

[1] This report will appear in six parts. The cost of the pages in excess of those ordinarily accepted from one contributor is met by the New York Botanical Garden.

[2] For a discussion of the history of discovery of Tafelberg and the itinerary of the Garden's 1944 explorations, see the written accounts: "Notes on the geology and geography of Tafelberg, Suriname." Geogr. Rev. 35: 563–579. 1945; "The first Botanical Exploration of Table Mountain in Surinam." Jour. N. Y. Bot. Gard. 46: 253–272, 277–287. 1945.

In all, more than 2300 collections were made, some 775 in British Guiana and the remainder in Surinam. In addition, numerous collections separately made by Fanshawe have been studied. It is proposed to report on the botanical results of these collections in a series of papers, of which this is the first. Specialists whenever available have been called upon to review the material of their interest. Their findings appear under the reviewer's own name. In the final paper, it is hoped to summarize an evaluation of the ecology and phytogeographic significance of floras of Tafelberg and the Kaieteur Plateau.

It is my pleasant duty to make grateful acknowledgment to the many who have been instrumental in making the exploration possible, and to those who have participated in the study of the collected materials.

Financial support was generously given by the John Simon Guggenheim Memorial Foundation, the American Philosophical Society, Mr. Pierre Jay of New York and the New York Botanical Garden.

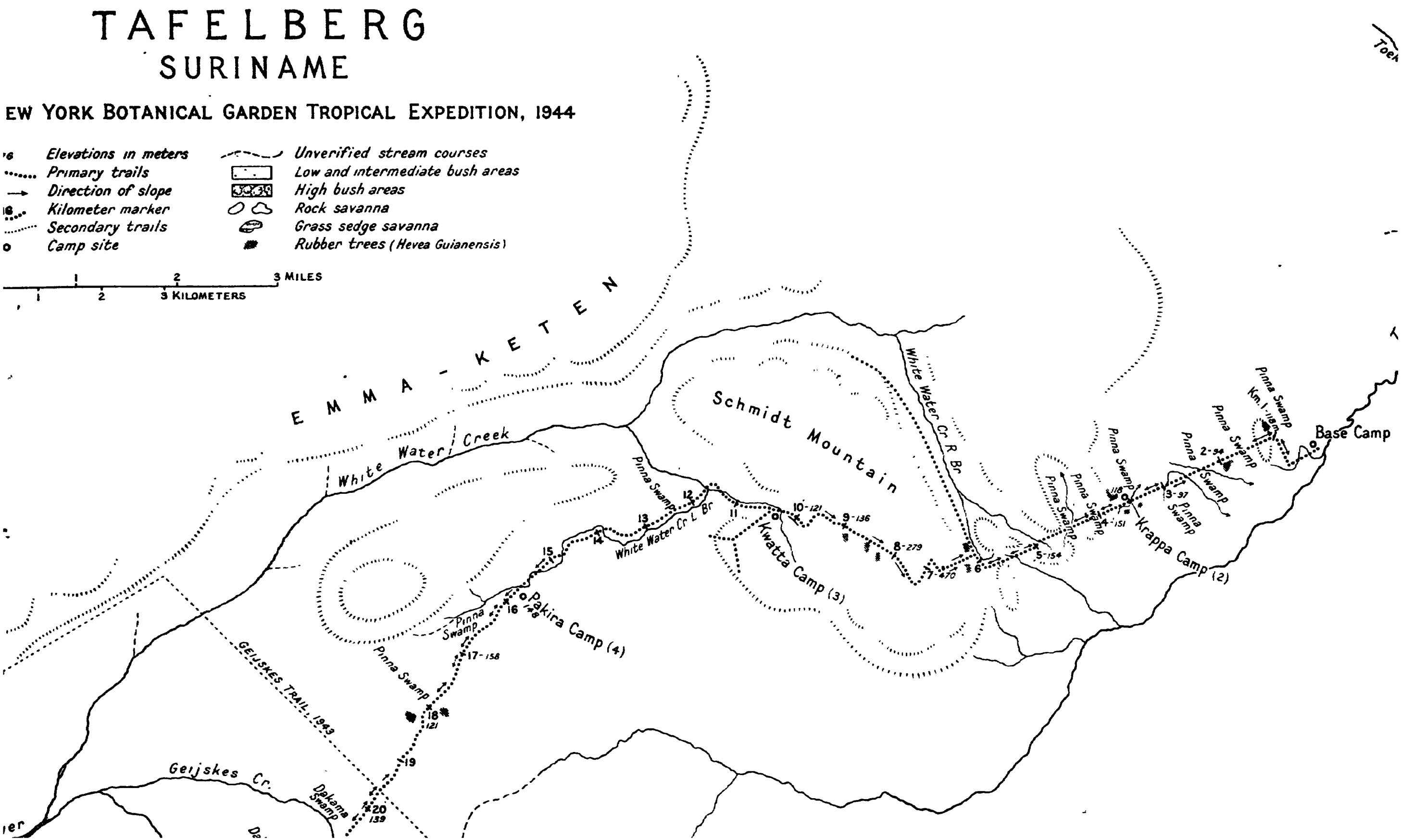
In British Guiana, the field study was skilfully planned and directed by Mr. D. B. Fanshawe, who in his own right is a competent botanist and who has profound and intimate knowledge of the Guianan flora. The cooperation of the Forestry Department and the assignment of its trained field crew brought results far beyond that which might have been expected from so short a visit to British Guiana.

The Tafelberg expedition could not have accomplished its purpose but for the unstinted help given to us by all in Surinam (Dutch Guiana). To His Excellency, the Governor, to the many officials of the Surinam Government, and particularly to Dr. D. C. Geijskes and Mr. F. H. Schols, grateful acknowledgment is made for assistance and encouragement.

But most of all the writer is grateful to Professor and Mrs. Gerold Stahel. Their gracious courtesies and great material help made my stay in Paramaribo delightful, and the expedition itself an assured success. It gave me much pleasure and satisfaction to name one of the larger and lovelier falls dropping from Table Mountain for Mrs. Stahel, calling it Lisa Falls.

To the personnel of the United States Army in Surinam, particularly to Colonels L. H. Schonnmaker and W. W. Walmsley, deepest appreciation is given. Access to the Army Commissary made it possible for us to obtain important supplies and medicines otherwise unavailable in the colony. During the entire expedition, we were kept under constant and comforting surveillance from the air by Colonel Walmsley and his fellow pilots. Repeatedly mail, newspapers, and much-needed replenishing supplies were dropped to us by parachute.

Finally, to my chief assistant, Lodewijk Schmidt, experienced native bushman and explorer; Tempico, competent headman of our crew of Carib Indian porters; the six Indian carriers; and Elmond, son of the bush negro chief of the Saramacca River Djukas, my affectionate thanks are given. All


TAFELBERG
SURINAME
EW YORK BOTANICAL GARDEN TROPICAL EXPEDITION, 1944
Elevations in meters
Primary trails
Direction of slope
Kilometer marker
Secondary trails
Camp site
Unverified stream courses
Low and intermediate bush areas
High bush areas
Rock savanna
Grass sedge savanna
Rubber trees (Hevea Guianensis)
1 2 3 MILES
1 2 3 KILOMETERS
EMMA-KETEN
White Water Creek
Schmidt Mountain
White Water Cr R Br
White Water Cr L Br
Base Camp
Krappa Camp (2)
Kwatta Camp (3)
Pakira Camp (4)
Pinna Swamp
Km. 1-118m
GEIJSKES TRAIL 1943
Geijskes Cr.
Dakama Swamp

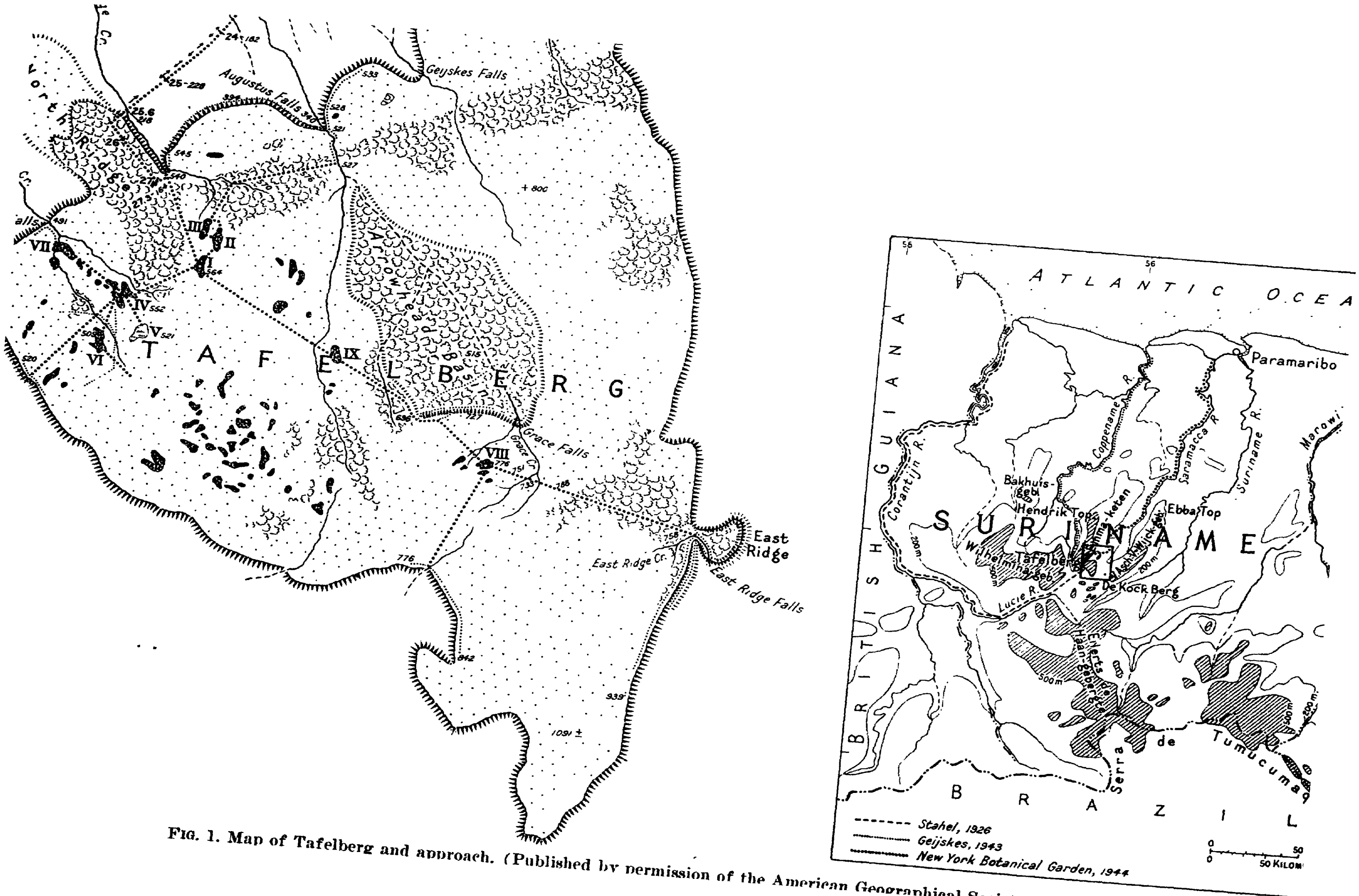


FIG. 1. Map of Tafelberg and approach. (Published by permission of the American Geographical Society.)

explorers must finally admit that such men are the backbone of expeditions, without whom nothing can be achieved.

No enumeration is made of the large number of collaborators who have lent their experience and authority to the more effective report on the expedition's collections. Their names appear as the authors of their respective reviews. I am admiringly grateful to them all.

Field work in British Guiana was done with Mr. D. B. Fanshawe, and that in the coastal areas of Surinam with Professor Gerold Stahel. To obviate the repetition of our personal names in citation, the numbered series collected by Professor Stahel and me, those collected by Mr. Fanshawe and me, and those made independently by me are given below. All specimens collected independently by Mr. Fanshawe are indicated by "F" preceding the exsiccatae numbers, for example "F2079." Collecting localities, camp sites, streams, and other pertinent physical features on Tafelberg and the approach to it, are shown on the accompanying map (fig. 1).

Surinam: *Maguire & Stahel.*
 22707–22806. April 3–8. vicinity of Paramaribo.
British Guiana: *Maguire & Fanshawe.*
 22807–22952. April 13–21. Kamuni Creek, Groete Creek, Essequibo River.
 22953–23004. April 25–26. Bartica-Garraway Stream, Kangaruma Road.
 23005–23049. April 26–27. Potaro River, Kangaruma—Tukeit.
 23050–23094. April 28–29. Tukeit to Kaieteur Plateau.
 23095–23472. April 30–May 15. Kaieteur Plateau.
 23473–23556. May 16–May 19. Kaieteur Plateau to Tukeit; Kaieteur Gorge.
 23557–23561. May 20—Bartica—Garraway Stream Road.
 23562–23582. May 23. Mazaruni Forest Station, Mazaruni River.
Surinam: *Maguire & Stahel.*
 23583–23602. June 2. Paramaribo—Carl Francois Road.
 23603–23737. June 3–4. Sectie O, Zanderij.
Surinam: *Maguire.*
 23738–24065. June 12–July 4. Saramacca River.
 24066–24087. July 4–July 8. Toekoemoetoe Creek—Tafelberg Creek.
 24088–24196. July 8–July 31. Line from Base Camp to Tafelberg.
 24197–24817. August 1–September 21. Tafelberg.
 24818–24890. Sept. 21–Oct. 4. Line from Tafelberg to Base Camp.
 24891–24918. Oct. 5–Oct. 8. Tafelberg Creek, Toekoemoetoe Creek.
 24919–24952. Oct. 8–13. Saramacca River.
Surinam: *Maguire & Stahel.*
 24953–25072. Oct. 18–Oct. 20. Zanderij.

Fungi[3]

PHYSARACEAE

PHYSARUM COMPRESSUM Alb. & Schw. SURINAM: east side, savanna, Zanderij I, *25055 F*. Developed on aroid cuttings in the New York Botanical Garden. Widely distributed.

[3] By Fred J. Seaver.

PEZIZACEAE

COOKEINA SULCIPES (Berk.) Kuntze. SURINAM: on rotten wood, in open high bush, base of north escarpment, Tafelberg, *24312 F*. Common throughout the tropics of the world.

MELASTIZA ASPERRIMA (Ellis & Ev.) Seaver. SURINAM: pina swamp, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24149 F*. Formerly known from Nicaragua to Mexico and the West Indies.

XYLARIACEAE

XYLARIA CUBENSIS Mont. SURINAM: on decaying wood, in montane forest, line beyond Pakira Camp (4), Coppenam River Headwaters, *24168 F*.

XYLARIA DENDROIDEA Cooke & Massee. (Fig. 2.) SURINAM: locally common on fallen decaying log, montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24145F*; on decorticated log, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24148 F*. Specimens were sent to Dr. David Linder of Harvard who replied as follows: "Thank you very much for the beautiful specimen of what you have called *Xylaria dendroidea* Cke. & Mass. On seeing this specimen I looked in our herbarium and there it is under the name of *Thamnomyces Chamissonis* Ehr. It is identical with your specimen and for that reason I suspect that Cooke and Massee's name is a later synonym. The material that we have also comes from Surinam, although the type of *Th. Chamissonis* is said by Saccardo to have been described from Brazil, a fact that would not be surprising since the Guianas merge more or less with Brazil as the hinterland and mountains slope downwards towards the east."

XYLARIA GRAMMICA Mont. SURINAM: on fallen log, vicinity Krappa Camp (2), Saramacca River Headwaters, *24144 F*.

XYLARIA GUIANENSIS Mont. SURINAM: on decaying wood, high mixed wallaba forest, south base of Table Mountain, km. 24.5, *24830 F*.

XYLARIA MULTIPLEX (Kunze) Berk. & Curt. SURINAM: on decorticated log, below west escarpment, Tafelberg, *24681 F*.

XYLARIA sp. *24193 F*, *24264 F*, *24550 F*, and *24630 F* are all sterile, and some may be sterile forms of *X. dendroidea*.

POLYPORACEAE

FOMES AUSTRALIS (Fries) Cooke. SURINAM: locally common, in high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24509 F*, *24618 F*.

FOMES PSEUDOSENEX Murr. SURINAM: bracket, tawny beneath, along east-facing slopes above escarpment, 300 meters south of East Ridge, Tafelberg, *24551 F*.

POLYPORUS ALBOGILVUS Berk. & Curt. SURINAM: bracket, rusty-brown above, white-margined, hymenium becoming pubescent, in wallaba forest, along line between Black Water Camp (5) and Pakira Camp (4), Coppenam River Headwaters, *24839 F*.

POLYPORUS CORROSUS Murr. SURINAM: yellow-brown, uniform throughout, dakama bush, bottom of Arrowhead Basin, Tafelberg *24616 F*. Previously known from southern Florida, Bahamas, Cuba, and Jamaica.

POLYPORUS FULVOCINEREUS (Murr.) Overholts. SURINAM: Posoegronoe,

Saramacca River, *24033 F*. Formerly known from Cuba, Jamaica, Hispaniola, St. Croix, and Barbados.

POLYPORUS LICNOIDES Mont. SURINAM: gold-brown, uniform throughout,

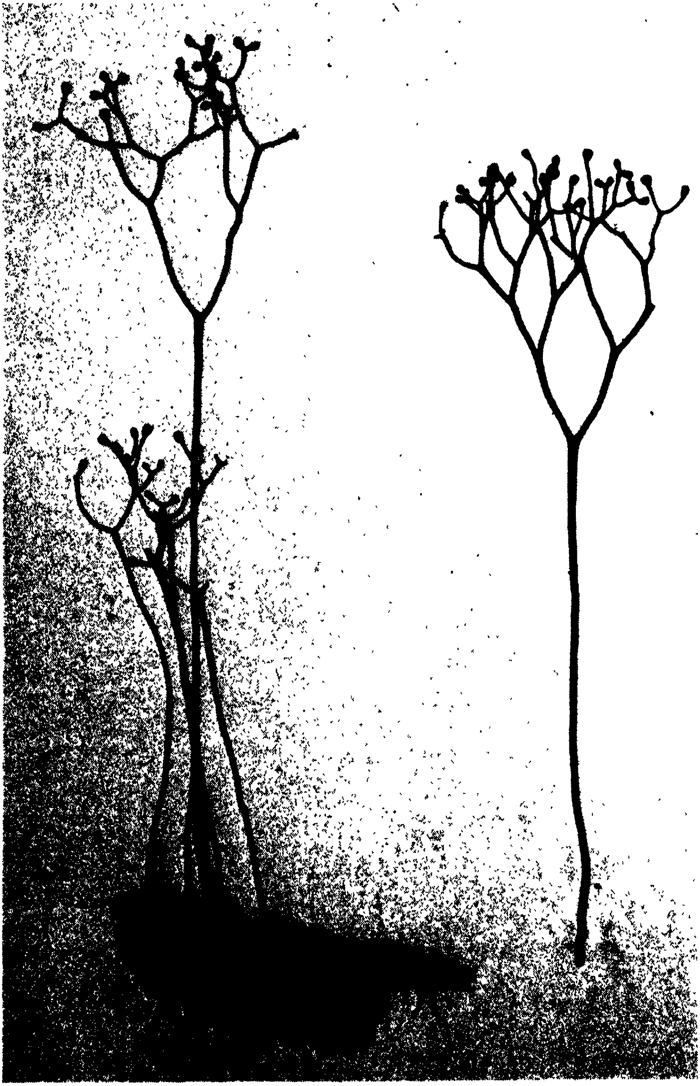


FIG. 2. *Xylaria dendroidea* Cooke & Massee, an unusual and rare fungus of Surinam. *Maguire 24145 F*.

dakama bush, bottom of Arrowhead Basin, Tafelberg, *24615 F*. Previously known from tropical America, the Gulf States, and tropical Asia.

TRICHAPTUM TRICHOMALLUM (Berk. & Mont.) Murr. SURINAM: brown-

ish-purple, on fallen log, montane forests, vicinity Krappa Camp (2), Saramacca River Headwaters, *24138 F*. Central America, Cuba, Jamaica, and South America.

AGARICACEAE

LENTINUS CRINITUS (L.) Fries. SURINAM: on fallen tree, low bush, 1.5 km. west of Savanna IV, Tafelberg, *24411 F*. This species which is very variable in form and consequently described under many names is widely distributed throughout our tropical and subtropical regions.

SCHIZOPHYLLUM COMMUNE Fries. SURINAM: locally common, fleshy, pinkish-white, high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24506 F*. Very common and widely distributed throughout temperate and tropical America.

THELEPHORACEAE

STEREUM DECOLORANS (Berk. & Curt.) Lloyd. SURINAM: stipe varnished, high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24508 F*.

STEREUM HYDROPHORUM Berk. SURINAM: on small tree in low forest, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24151 F*.

HYPOLYSUS MONTAGNEI Berk. SURINAM: west escarpment, Tafelberg, *24680 F*. Widely distributed through the tropics.

CLADONIACEAE

CLADONIA PYCNOCLADA (Pers.) Nyl. *C. falax* des Abb. SURINAM: common under shrubs and border of bush, Savanna I, Tafelberg, *24259 L*, *24260 L*.

PARMELIACEAE

POLYSTROMA FERNANDEZII Clem. *Ozocladium Leprieurii* Mont. SURINAM: twigs of living shrub, high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24507 L*. Dr. C. W. Dodge, who determined the species, writes: "In reply to your letter of November 8, I was very glad to receive the specimen of *Polystroma Fernandezii* Clem. (*Ozocladium Leprieurii* Mont.). No one has ever thoroughly monographed this genus of the Thelotremaceae. It is apparently confined to Spain and Guiana and is seldom collected. I saw a specimen while I was at Harvard. Clemente's original description is unavailable, and Montagne failed to find mature spores. It is possible that if the *Polystroma* was described from Spain the Guiana material is a different species. Certainly the finding of the same species in both localities would be very unusual since the morphology is so distinctive everyone has been content to identify their material as this species. We are very glad to have this material for our Herbarium."

USNEACEAE

SIPHULA FASTIGIATA Nyl. SURINAM: locally common, encrusting bed rock, Savanna VIII, Tafelberg, *24509 L*. Dr. C. W. Dodge writes: "As no member of this genus has been found fertile, its systematic position is uncertain. In structure of the thallus, this species closely resembles *Dactylina madreporiformis* (Ach.) Tuck. although it differs in habit and method of branching."

Hepaticae[4]

LEPIDOZIACEAE

BAZZANIA GRACILIS (Hampe & Gottsche) Stephani. SURINAM: on tree, high forest, 100 meters west of Grace Falls, Arrowhead Basin, Tafelberg, *24513 H;* steep east-facing slopes, high forest, 300 meters south of East Ridge, Tafelberg, *24548 H.* The West Indies and South America.

METZGERIACEAE

METZGERIA HAMATA Lindb. SURINAM: on tree in dakama forest, 1 km. northwest of East Ridge, Tafelberg, *24547 H.* Broadly distributed in tropical and temperate regions of the world.

Musci[5]

SPHAGNACEAE

SPHAGNUM PALUSTRE L. SURINAM: south savanna, vicinity Arawak village of Mata, *24986 M;* frequent, wet rocks, high bush, base north escarpment, Tafelberg, *24339 M–1.* Widely distributed in North America, Europe, Asia. This almost cosmopolitan species is not generally credited to South America. It has an extensive synonymy, however, and no doubt appears under other names. The determination has been confirmed by Dr. Andrews.

DICRANACEAE

CAMPYLOPUS FILIFOLIUS (Hornsch.) Mitt. SURINAM: high bush, base south cliffs, Arrowhead Basin, Tafelberg, *24458 M,* in part. Guatemala, Costa Rica, Brazil.

CAMPYLOPUS RICHARDI Brid. SURINAM: frequent, wet rocks, high bush, base north escarpment, Tafelberg, *24339 M–4;* extensive rock and pigmy bush openings, Savanna VIII, *24443 M–2.* Mexico, Central America, West Indies, South America. These collections are sterile, more slender than the typical form, and with the hyaline leaf tips poorly developed, but show the characteristic costal structure and leaf cells.

EUCAMPTODONTOPSIS PILIFERA (Mitt.) Broth. SURINAM: frequent, on tree trunks, bush, Savanna VIII, Tafelberg, *24509 M;* precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24552 M.* West Indies, Trinidad. Not previously recorded from the South American mainland.

LEUCOLOMA SERRULATUM Brid. SURINAM: rocks, high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24521 M;* common epiphyte on *Clusia* bush, 1 km. west of East Ridge, Tafelberg, *24598 M–1.* Mexico, Central America, West Indies, British Guiana. A frequent species in tropical North America but uniformly sterile in my experience.

LEUCOBRYACEAE

OCTOBLEPHARUM ALBIDUM Hedw. SURINAM: frequent, drying cliffs, west escarpment, Tafelberg, *24679 M.* Pantropical distribution, usually on tree trunks at low altitudes.

[4] By Margaret H. Fulford.
[5] By Edwin B. Bartram.

OCTOBLEPHARUM CYLINDRICUM Schp. SURINAM: on *Mauripa*, east side, savanna, Zanderij I, *25059 M*. British Honduras, Dominican Republic, northern South America. Readily distinguished from the ubiquitous *O. albidum* when in fruit by the narrowly cylindrical capsules and longer setae.

LEUCOBRYUM CRISPUM C. M. SURINAM: in low forest, along line between Black Water Camp (5) and Table Mountain, *24193 M*; frequent, high bush, northwest Savanna VIII, Tafelberg, *24434 M–3*. West Indies, northern South America. The slender, crisped leaves give this species a characteristic appearance.

LEUCOBRYUM MARTIANUM (Hornsch.) Hampe. SURINAM: pina swamp, vicinity Base Camp (1), Tafelberg Creek, Saramacca River Headwater, *24119 M*; frequent, wet rocks, high bush, base north escarpment, Tafelberg, *24339 M–1*. Central America, West Indies, northern South America. Readily known by the falcate-secund leaves with the leucocysts in two layers throughout the leaf.

CALYMPERACEAE

SYRRHOPODON PROLIFER Schwaegr. SURINAM: cliffs, drier places, below north escarpment, between North Ridge and Augustus Creeks, Tafelberg, *24186 M* in mixture. Mexico, West Indies, northern South America.

SYRRHOPODON LEPRIEURII Mont. SURINAM: high bush, base south cliffs, Arrowhead Basin, Tafelberg, *24458 M–1*, in part Guiana. A rare and localized species apparently confined to the Guiana region.

CALYMPERES GUILDINGII Hook. & Grev. SURINAM: precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24549 M–2*. West Indies. This is apparently the first record of the species in South America.

Calymperes (*Eucalymperes*) **Maguirei** Bartr. sp. nov. Caespites atro-lutescentes, nitidi. Caules 3–4 mm. alti. Folia conferta, sicca flexuosa, humida stricta, fragilissima, ad 15 mm. longa, e basi oblonga serrulata, 2.5–3 mm. longa anguste lineari-lingulata, acuta, lamina inferne sensim contracta, longe (circa 3 mm.) supra basin evanida; margines incrassato-limbati, ubique minute et remote denticulati; costa infra apicem evanida; cellulae superiores rotundatae, incrassatae, laevissimae, diam. 8–12 μ.

Plants glossy, yellowish in younger parts, becoming dark brown with age. Stems short, 3–4 mm. high. Leaves crowded, flexuous when dry, very fragile, to 15 mm. long, narrowly linear-ligulate from an oblong, serrulate base 2.5–3 mm. long, acute, lamina gradually narrowed below to a stretch of bare costa about 3 mm. long extending to the shoulders of the leaf base; margin thickened forming an opaque border, remotely and minutely denticulate all around; costa strong, triangular in cross-section, prominent at back, ending just below apex, smooth on both sides; cells of lamina smooth, rounded, diam. 8–12 μ; cancellinae well defined, ending in acute angles above with the cells in two layers; teniolae none. Fruit unknown.

TYPE: precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, Surinam, October 29, 1944, *Maguire 24549 M*. A very singular species closely allied to *C. petiolatum* Bartr. of Fiji but quite distinct in the twice longer leaves with a narrowly linear blade. In habit and appearance *C. Maguirei* closely resembles *C. lonchophyllum* Schwaegr., but the unique leaf structure with the blade contracted to a stretch of bare costa above the basal leaf shoulders is a marked feature shared by only two other species, *C. petiolatum* of Fiji and *C. Ebaloi* Bartr. of the Philippines.

BRYACEAE

RHODOBRYUM BEYRICHIANUM (Hornsch.) Par. SURINAM: frequent, high bush, northwest of Savanna VIII, Tafelberg, *24435 M*. Mexico, Central America, South America.

PHYLLOGONIACEAE

PHYLLOGONIUM FULGENS (Sw.) Brid. SURINAM: common, epiphytic on *Clusia* bush, 1 km. west of East Ridge, Tafelberg, *24598 M*. Mexico, Central America, West Indies, South America. A conspicuous moss characterized by the glossy, crowded, keeled leaves in two lateral rows.

HOOKERIACEAE

CALLICOSTELLA ASPERA (Mitt.) Jaeg. SURINAM: Toekoemoetoe Creek, Saramacca River, *24073 M*. Northern South America. The distinctions between this species and *C. scabriseta* (Hook.) Jaeg. are very slight, and it is probable that they are both representative of a single specific concept.

THUIDIACEAE

THUIDIUM ACUMINATUM Mitt. SURINAM: frequent, high bush, northwest Savanna VIII, Tafelberg, *24433 M–1*, *24434 M–1*. Jamaica. This species does not seem to have been recorded before from South America.

PLAGIOTHECIACEAE

PILOSIUM CHLOROPHYLLUM C. M. SURINAM: Posoegronoe, Saramacca River, *24033 M–1*. Central America, Panama, West Indies, South America. This species has a rather extensive synonymy as noted by Grout (Bryologist **48**: 68. 1945).

SEMATOPHYLLACEAE

SEMATOPHYLLUM SUBSIMPLEX (Hedw.) Mitt. SURINAM: Posoegronoe, Saramacca River, *24033 M*; frequent, wet rocks, high bush, base north escarpment, Tafelberg, *24339 M–3*. Mexico, Central America, West Indies, South America. A frequent and widely distributed tropical American moss.

TRICHOSTELEUM PAPILLOSUM (Hornsch.) Jaeg. SURINAM: overhanging Tafelberg Creek, Saramacca River Headwaters, *24897 M*. Guiana, Brazil.

Pteridophyta[6]

The present list of Pteridophyta collected by Dr. Bassett Maguire and his associates in British Guiana and Surinam in 1944 may be considered as a supplement to Dr. O. Posthumus' *Ferns of Surinam*,[7] which actually treats not only the Surinam species but also those known from British Guiana and French Guiana as well.

Posthumus records 354 species from the Guianas, of which 190 are known from Surinam. However, it must be remarked that Posthumus held a very broad specific concept and that critical work on his material might show the

[6] By William R. Maxon & C. V. Morton. Published by permission of the Secretary of the Smithsonian Institution.

[7] Published as a supplement to *Flora of Suriname* by A. Pulle, pp. 1–196. 1928.

presence of a number of additional species. The present list adds about 20 species to the known flora, some of them new, and others representing notable extensions of range. Most of the new records are based on plants collected at Tafelberg. The fern flora of this mountain shows some relationship with that of Mount Roraima, especially in the presence of the genus *Syngramma.* It is, however, far less rich in species and is not a center of endemism for Pteridophyta.

The only significant work published on Guiana ferns since Posthumus' work is Mr. A. H. G. Alston's "Pteridophyta collected by the Oxford Expedition to British Guiana, 1929,"[8] which adds a number of species to the known flora.

The present enumeration follows the order of genera given in Christensen's Supplement III of his *Index Filicum.* His nomenclature is followed also, except for the recognition of *Polytaenium, Dicranopteris, Actinostachys,* and *Amphidesmium* as generically distinct from *Antrophyum, Gleichenia, Schizaea,* and *Alsophila* respectively.

HYMENOPHYLLACEAE

Trichomanes anomalum Maxon & Morton, sp. nov. Planta parva, frondibus caespitosis ad 7 cm. longis; rhizoma breve, erecta, hirsuta; stipites breves (usque ad 16 mm. longi) vel subnulli, apicem versus late alati, longe stellato-hirsuti, pilis breviter stipitatis, radiis 3–6, patentibus; lamina oblongo-linearis, usque ad 5.5 cm. longa et 1.7 cm. lata, apice obtusa, basi truncata, non angustata, pinnatipartita, rhachi utroque latere ca. 0.75 mm. alata; segments 14–18-juga, patentia, 7–9 mm. longa, 3.5–4 mm. lata, apice rotundata, pinnato-lobata, lobis utroque latere 5 vel 6, 0.5–1 mm. longis, rotundatis; venae 5- vel 6-jugae, basales furcatae, superiores simplices, in pagina superiore perspicue alatae, alis disjunctis, patentibus, viridibus, deltoideis vel triangularibus, margine et apice hirsutis; lamina tenuiter membranacea, margine perspicue ciliata, pilis stellatis, sessilibus, longe-radiatis, radiis 3–6, in venis utrinque longe stellato-pilosa, pilis breviter stipitatis, longe-radiatis, radiis unicellularibus; involucrum terminale, solitarium, obconicum, breve, ca. 1.5 mm. longum, toto immersum, truncatum, ciliatum, labiis nullis; receptaculum longe exsertum.

TYPE: U. S. National Herbarium, No. 1,879,309. On stream bank, Kaieteur Savannas, British Guiana, May 12, 1944, *Maguire & Fanshawe 23414.*

By the conspicuous accessory wings along the veins of the upper surface the present species can be related only to *T. pilosum* Raddi. These wings are entirely similar to those occurring in several species of *Hymenophyllum,* particularly to those of *H. lobato-alatum.* They are small green outgrowths from the back of the veins and are composed of cells similar to those of the ordinary leaf tissue. They are disposed in a plane perpendicular to the leaf surface. *Trichomanes pilosum* is a much larger plant, coarser in every way, and the leaf segments have many more pairs of veins and lobes. Also, the blade is reduced toward the base, rather than truncate as in the present species.

[8] Kew Bull. 1932: 305–317.

The solitary terminal involucre may prove to be characteristic of the present species also.

TRICHOMANES ARBUSCULA Desv. BRITISH GUIANA: on rocks or fallen logs, Takutu Creek to Puruni River, Mazaruni River, *F2129;* Kaieteur Savannas, *23391;* one mile below Kaieteur Falls, *23420, 23421.* SURINAM: low forest, vicinity of Black Water Camp (5), Coppenam River Headwaters, *24174a.*

TRICHOMANES BOTRYOIDES Kaulf. SURINAM: locally frequent in recess in clay bank in high forest, North Ridge Creek, Tafelberg, *24810.*

TRICHOMANES CELLULOSUM Klotzsch. BRITISH GUIANA: in low bush, Kaieteur Savannas, *23392.* SURINAM: frequent in stream bed in dakama forest, Arrowhead Basin, Tafelberg, *24621.* Not previously reported from Surinam.

TRICHOMANES CRISTATUM Kaulf. BRITISH GUIANA: abundant on fallen logs, wet cliffs, or sometimes on dry rock-shelves, Takutu Creek to Puruni River, Mazaruni River, *F2128;* Tukeit to Kaiatuk Plateau, *23088;* one mile below Kaieteur Falls, *23428, 23429.* SURINAM: Black Water Camp (5), Coppenam River Headwaters, *24174;* Tafelberg, *24293, 24367, 24504, 24770.* The group of species related to *T. crispum* is a complex one. *Trichomanes cristatum* is here recognized in its broadest sense, following Posthumus. A monographic study might show that the collections here listed could be segregated into two or more species.

TRICHOMANES ELEGANS L. C. Rich. BRITISH GUIANA: tufted erect plants 30–45 cm. high, on moist rocks, mature leaves with a metallic blue-green coloration, one mile below Kaieteur Falls, *23422,* depauperate, *23432, 23433;* Takutu Creek to Puruni River, Mazaruni River, *F2170.* Distinguished from the related *T. rigidum* Swartz by its alate rhachis, this being bisulcate and more or less pilose on the ventral surface. The rhachis of *T. rigidum* is terete and glabrate throughout.

TRICHOMANES HOOKERI Presl. BRITISH GUIANA: frequent on wet rocks, Potaro River Gorge, *23532.* SURINAM: between km. 16 and 19, Coppenam River Headwaters, *24168;* Arrowhead Basin, Tafelberg, *24622.* Material of typical *T. Hookeri* from Jamaica and the other islands of the Greater Antilles is rather uniformly large and of distinctive appearance. The smaller plant of Martinique, Guadeloupe, and the Guianas is referred by Alston to *T. cordifolium* (Fée) Alston (based on *Didymoglossum cordifolium* Fée, from Martinique), but it does not seem to us specifically separable.

TRICHOMANES HOSTMANNIANUM Klotzsch. BRITISH GUIANA: common on rocks, Tukeit, *23541.* SURINAM: Black Water Camp (5), Coppenam River Headwaters, *24175;* km. 68, vicinity of Sectie O, *24990.* Distinguished from *T. pinnatum* Hedw., which is habitally similar, by the absence of false crossveins between the primary veins.

TRICHOMANES HYMENOPHYLLOIDES v. d. Bosch. BRITISH GUIANA: repent on tree trunk, one mile below Kaieteur Falls, *23423.* Apparently included by Posthumus in *T. pyxidiferum* L., which differs in the presence of false veins, among other characters.

TRICHOMANES KRAUSSII Hook. & Grev. SURINAM: frequent on wet rocks and walls, north escarpment, Tafelberg, *24339.* A common and widespread species.

TRICHOMANES PEDICELLATUM Desv. SURINAM: Vicinity of Krappa Camp (2), Saramacca River Headwaters, *24143;* frequent on tree trunks, maka-

pina-tete swamp, Coppenam River Headwaters, *24849*. Related to *T. Tuerckheimii* (of the section *Lacostea*), from which it is easily distinguished by its deeply pinnatifid pinnae.

TRICHOMANES PILOSUM Raddi. BRITISH GUIANA: on tree trunks or fallen logs, Sebai Creek, Kaituma River, *F2425*. Habitally similar to *T. cristatum*, but distinguished by the conspicuous accessory wings on the veins of the upper surface and by its dense pubescence.

TRICHOMANES PINNATUM Hedw. SURINAM: a frequent terrestrial species in high bush or low forest, Black Water Camp (5), Coppenam River Headwaters, *24173;* Arrowhead Basin, Tafelberg, *24448;* lower North Ridge Creek, Tafelberg, *24809a*. Here construed to include *T. pennatum* Kaulf., recognized as distinct by Posthumus and Alston.

TRICHOMANES RIGIDUM Swartz. SURINAM: frequent, in high forest, fronds deep pellucid green, East Ridge Creek Gorge, Tafelberg, *24537*.

TRICHOMANES TRIGONUM Desv. SURINAM: frequent in rocks in stream bed, high mixed forest, Arrowhead Basin, Tafelberg, *24620*. The specimen is not typical, having the pinnae more deeply pinnatifid than usual. Not previously reported from Surinam.

TRICHOMANES TROLLII Bergdolt. BRITISH GUIANA: Takutu Creek to Puruni River, Mazaruni River, *F2114*. SURINAM: locally frequent on clay banks in mixed montane forests, vicinity of Krappa Camp (2), Saramacca River Headwaters, *24137;* lower North Ridge Creek, Tafelberg, *24809*. This is doubtless included by Posthumus in *T. diversifrons* (Bory) Mett., but that species seems sufficiently distinct by the characters originally pointed out by Bergdolt. *Trichomanes Trollii* has been reported in the literature only from Bolivia, but it has been collected previously in British Guiana by Tutin (No. 383, Cuyuni River). A related form, perhaps undescribed, was collected long ago at Panure, Río Vaupes, Colombia, by Spruce (No. 2944). This was distributed as *T. elegans* Rudge, which, from the illustration, was apparently based on a mixture of *T. botryoides* and either *T. Trollii* or *T. diversifrons*. In any case the specific epithet is invalidated by the earlier *T. elegans* L. C. Rich.

TRICHOMANES TUERCKHEIMII Christ. SURINAM: repent epiphyte, vicinity of Krappa Camp (2), Saramacca River Headwaters, *24141*. Related to the widespread *T. Ankersii* Parker, but distinguished by its broad, entire or lightly crenulate pinnae. It was described originally from Loreto, Peru. At the same time Christ reported it from Guatemala, and it has been collected also in Colombia (La Concepción, *Archer 1917*, and Barranca Bermeja, *Haught 1351*). Not previously reported from Surinam.

TRICHOMANES VITTARIA DC. SURINAM: infrequent, km. 18.5, Coppenam River Headwaters, *24839*. A rare and distinctive species known until recently only from the Guianas and northern Brazil. In 1943 it was found also in Amazonian Colombia (Cerro Chiribiquete, Río Macaya, Upper Apaporis Basin, Vaupes, alt. 2100 feet, *Schultes 5653*).

HYMENOPHYLLUM FENDLERIANUM Sturm. SURINAM: frequent epiphyte, in swamps, 1.5 km. south of Savanna I, Tafelberg, *24363*. Easily distinguished from the other species of the Guianas by the glabrous, conspicuously undulate-crispate fronds. Reported from British Guiana but not known previously from Surinam.

HYMENOPHYLLUM HIRSUTUM (L.) Swartz. *H. ciliatum* Swartz. BRITISH

GUIANA: on moist rock, 1 mile below Kaieteur Falls, *23424*. SURINAM: on dripping walls, west of Grace Falls, Tafelberg, *24513;* below south escarpment of Arrowhead Basin; Tafelberg, *24496*.

HYMENOPHYLLUM POLYANTHOS (Swartz) Swartz. SURINAM: on mossy fallen tree trunks, west escarpment, Tafelberg, *24694;* Arrowhead Basin, Tafelberg, *24466;* 2 km. south of East Ridge, Tafelberg, *24579a*.

HYMENOPHYLLUM TRAPEZOIDALE Liebm. SURINAM: common in deep moss on tree trunks, 2 km. south of East Ridge, Tafelberg, *24579*. Known previously only from Mexico and Colombia.

HYMENOPHYLLUM sp. SURINAM: North Ridge, Tafelberg, *24240*. Allied to *H. protrusum* Hook.

CYATHEACEAE

HEMITELIA HIRSUTA (Desv.) Weatherby. *H. Parkeri* Hook. BRITISH GUIANA: infrequent, along trail in dense second growth in windfall opening, Kamuni Creek, Essequibo River, *22857*. Juvenile.

HEMITELIA MACROCARPA Presl. BRITISH GUIANA: tree-fern 2–5 m. high, Kaieteur Savannas, *23387*. SURINAM: 1.5 km. southwest of Savanna II, Tafelberg *24359*. Not known previously from Surinam.

ALSOPHILA MARGINALIS Klotzsch. SURINAM: tree-fern 3 m. high, on slopes overlooking a stream in high forest, East Ridge Gorge, Tafelberg, *24544*. This is a fine specimen of a very rare species of the section *Trichopteris,* described originally from Mount Roraima and until now known otherwise only from Mexico.

ALSOPHILA MICRODONTA Desv. SURINAM: km. 68 and 70, vicinity Sectie O, *23626, 24992*. A common and widespread species.

ALSOPHILA OBLONGA Klotzsch. SURINAM: tree-ferm 2.5 m. high, the trunk 5 cm. in diameter, stem exuding copious gelatine, in bamboo thicket in small opening in high forest near escarpment, south of East Ridge, Tafelberg, *24543;* Arrowhead Basin, Tafelberg, *24495a*, sterile juvenile plant. The identification has been confirmed by comparison with a fragment of the type (*Schomburgk 1125*, from British Guiana) at the New York Botanical Garden. Herbarium material currently referred to *A. oblonga* apparently represents several species.

ALSOPHILA PUNGENS (Willd.) Kaulf. BRITISH GUIANA: stem 12 inches long, the leaves 10–15, 5–7 feet long, frequent in dense second growth in windfall opening, Kamuni Creek, Essequibo River, *22854*.

AMPHIDESMIUM ROSTRATUM (Humb. & Bonpl.) J. Smith. BRITISH GUIANA: common on forest floor, the rhizome horizontal, coarse, Kamuni Creek, Groete Creek, Essequibo River, *22821a*.

POLYPODIACEAE

DRYOPTERIS EXTENSA (Blume) Kuntze. BRITISH GUIANA: near roadside, Garraway Stream, Potaro River, *22983*. This is one of the few Old World ferns that has become naturalized in the American tropics. It has been collected in Guadeloupe, St. Lucia, Tobago, Trinidad, and British Guiana. From the native species of the section *Cyclosorus* it is at once distinguished by the bright yellow glands on the veins beneath.

DRYOPTERIS HOSTMANNII (Klotzsch) Maxon & Morton. SURINAM: fre-

quent terrestrial fern in high mixed forest, at base of north escarpment, Tafelberg, *24304a.*

DRYOPTERIS MENISCIOIDES (Willd.) Kuntze var. CONFERTA Morton. BRITISH GUIANA: common on forest floor, Kamuni Creek, Essequibo River, *22821.* A widespread plant in South America, but not often collected. Called *Cyclodium meniscioides* by Posthumus.

DRYOPTERIS OCHROPTEROIDES (Baker) C. Chr. SURINAM: frequent, terrestrial fern in high forest below north escarpment, Tafelberg, *24345;* base of cliff, west of Grace Falls, Tafelberg, *24503.* A specimen from one mile below Kaieteur Falls, British Guiana, *23434*, is probably a juvenile of this species. This rare and distinctive species has a peculiar distribution. It has been known previously upon three collections from Jamaica, one from eastern Panama, and one from Colombia. The last is the basis of *Dryopteris popayanensis* (Hieron.) C. Chr.

DRYOPTERIS PROTENSA (Afzel.) C. Chr. var. FUNESTA (Kunze) C. Chr. BRITISH GUIANA: Kamuni Creek, Essequibo River, *22856, 22871.* SURINAM: vicinity of Krappa Camp (2), Saramacca River Headwaters, *24140;* Augustus Falls, base of north escarpment, Tafelberg, *24773.* This is considered by Alston to be specifically distinct from the African *D. protensa*, perhaps correctly.

DRYOPTERIS SANCTI-GABRIELI (Hook.) Kuntze. BRITISH GUIANA: Potaro River Gorge, *23525*, atypical and probably juvenile. SURINAM: in high mixed forest, lower North Ridge Creek, Tafelberg, *24815;* Arrowhead Basin, Tafelberg, *24468.* A rare species, not previously known from Surinam.

DRYOPTERIS SERRATA (Cav.) C. Chr. SURINAM: at km. 68, Sectie O, *24991.* A widespread common species.

DIDYMOCHLAENA TRUNCATULA (Swartz) J. Smith. BRITISH GUIANA: terrestrial fern forming large clumps with 8–12 fronds, Takutu Creek to Puruni River, Mazaruni River, *F2059.*

POLYBOTRYA CAUDATA Kunze. BRITISH GUIANA: climbing fern, leaves bipinnate, 4–5 feet long, dimorphic, fertile leaves 2, 2–3 feet long, in dense thickets in heavy mora forest, Kamuni Creek, Essequibo River, *22855.*

TECTARIA PLANTAGINEA (Jacq.) Maxon. SURINAM: frequent along streams on rocks, vicinity of Kwatta Camp (3), Coppenam River Headwaters, *24148;* km. 24.5, Coppenam River Headwaters, *24829.*

TECTARIA TRIFOLIATA (L.) Cav. SURINAM: locally frequent in high mixed forest, at base of north escarpment, Augustus Falls, Tafelberg, *24768.*

BOLBITIS ALIENA (Swartz) Alston. SURINAM: mossy boulders in high mixed forest, Augustus Falls, Tafelberg, *24767.*

Bolbitis Maguirei Maxon & Morton, sp. nov. Rhizoma repens, lignosum, brunneum, ca. 8 mm. diam., dense paleaceum, paleis anguste ovatis, attenuatis, usque ad 3 mm. longis et 0.8 mm. latis, imbricatis, brunneis, sublaceratis. Folia disticha, sterile fertili paulum longius. Folium sterile 100 cm. longum; stipes 40 cm. longus, 4–5 mm. diam., olivaceus, glaber, obscure paleaceus, paleis anguste ovatis, attenuatis, ca. 2 mm. longis, eroso-laceratis, clathratis, tenuissimis, adpressis, plerisque mox delapsis; lamina late oblonga, abrupte acuminata, 60 cm. longa, ca. 35 cm. lata, pinnata, rhachi sicut stipite hinc inde tenere paleacea; pinnae ca. 14- jugae, arcuatim adscendentes, lineares, acuminato-caudatae, 5- vel 6-jugae, inferiores petiolulatae (4–7 mm.), basi inaequali late cuneatae, subaequales, 24–28 cm. longae, 3–4.3

cm. latae, undulato-crenatae, superiores sensim minores, sessiles, leviter crenatae, pinna apicalis multo major, undulato-crenata, costis elevatis, parce paleaceis; costulae majores ca. 28-jugae, patentes, tenues, utrinque prominulae, marginem fere attingentes; maculae costales anguste subtriangulares, 7–9 mm. longae, 2.5–3 mm. latae; maculae costulares 2–4, elongatae, exappendiculatae; maculae alterae paucae, ambitu modoque variae, saepe appendiculatae, radiis simplicibus, exteriores apertae, venulis liberis hydathodis marginalibus vel submarginalibus gracillimis desinentibus. Folium fertile 85 cm. longum, stipite (45 cm.) et rhachi sicut folio sterili hinc inde tenere paleaceis; lamina anguste oblonga, apice acuta, 40 cm. longa, 15 cm. lata, pinnata; pinnae 15-jugae, remotae, lineares, apice obtusae, basi inaequali late cuneatae, petiolulatae (infimae 6–7 mm.), maximae 8.5 cm. longae, 12 mm. latae, marginibus subintegris; sporangia fusco-brunnea, crebra, fere ad marginem revolutam diffusa, costa non occulta; sporae subsphaeroideae, 44–56 μ diam., perspicue tuberculatae.

TYPE: U. S. National Herbarium, Nos. 1,879,451–2. Dense forest near Augustus Falls, Tafelberg, Surinam, September 15, 1944, *Maguire 24744*.

From Christensen's Revision[9] this species is most closely allied to *B. serratifolia* (Mertens) Schott, a rather widely distributed species which may be distinguished at once from the present by its uncinate-serrate rather than crenate-lobate pinnae. It is related also to *B. crenata* (Presl) C. Chr., which differs in its appendiculate maculae.

Bolbitis scopulina Maxon & Morton, sp. nov. Rhizoma repens, lignosum, brunneum, ca. 6 mm. diam., dense adpresso-paleaceum, paleis elongato-triangularibus, apice attenuatis, 1.5–3 mm. longis, 0.3–0.8 mm. latis, imbricatis, brunneis, opacis, fibrosis, hinc inde lacerato-dentatis. Folia disticha, pauca, inter se ca. 1 cm. remota, adscendentia, sterile quam fertili paulum longius. Folium sterile 60 cm. longum; stipes 30 cm. longus, 1.5–2 mm. diam., olivaceus, glaber, basi squamosus; lamina ambitu orbiculari-ovata, 30 cm. longa, ca. 25 cm. lata, pinnata, rhachi compressa, 3 cm. longa; pinnae 2-jugae cum impari, lanceolatae vel lanceolato-ellipticae, longe acuminatae, membranaceae, glabrae, basales oppositae, subpetiolulatae, 17 cm. longae, 4.5 cm. latae, basi inaequaliter cuneatae (postice dimidiatae), pinnae alterae alternae, semiadnatae, decurrentes, terminalis multo maxima, 27 cm. longa, 6.5 cm. lata, marginibus basin versus undulatis, superne remote et minute serratis, apicem versus leviter crenato-serratis; costulae majores ca. 15-jugae, angulo lato fere ad marginem egredientes, tenues; maculae costales humiles, lineares, majores 10–15 mm. longae et 2–3 mm. latae; maculae costulares (3 vel 4) ambitu costalibus simillimae, saepe appendiculatae, alterae varie dispositae, crassae, pleraeque hexagonae, majores appendiculatae, radiis simplicibus vel furcatis, minores et praesertim marginales exappendiculatae. Folium fertile 54 cm. longum; stipes gracilis, 43 cm. longus; lamina ambitu ovata, 11 cm. longa, 7 cm. lata, basi pinnata, sursum pinnatisecta, segmentis 2-jugis cum impari, lateralibus oppositis et aequalibus, ellipticis, 4–4.5 cm. longis, ca. 8 mm. latis, basalibus petiolulatis (2 mm.), superioribus semiadnatis, decurrentibus, segmento apicali anguste trilobato, longe decurrente, 8.5 cm. longo, marginibus integris; sporangia fere ad marginem tenuiter diffusa; sporae subglobosae, 50–55 μ diam., alatae.

[9] "On the American species of *Leptochilus*, Sect. *Bolbitis*," Bot. Tidssk. 26: 283–297. 1904.

TYPE: New York Botanical Garden. Mixed montane forest, on wet walls of lower North Ridge Creek, Tafelberg, Surinam, September 19, 1944, *Maguire 24814*. The present species belongs to the section *Anapausia,* but is evidently not closely allied to the other species of the section.

OLEANDRA ARTICULATA (Swartz) Presl. BRITISH GUIANA: dry rock ledge, one mile below Kaieteur Falls, *23431;* occasional in high mixed forest on trail from Kaiatuk to Tukeit, *23474*. SURINAM: frequent, climbing on damp shaded walls of gorge above Lisa Falls, Tafelberg, *24366*. Referred by Posthumus to *O. nodosa* (Willd.) Presl, which, as long ago pointed out,[10] must be regarded as a synonym.

OLEANDRA PILOSA Hook. BRITISH GUIANA: stem woody, procumbent, leaves crowded at apex, rare, on dry rock ledge, Kaieteur Savannas, *23142*.

NEPHROLEPIS PENDULA (Raddi) J. Smith. BRITISH GUIANA: tufted, short ascending rhizome, with 10–20 fronds, locally frequent in rock fissures in sandy soil, Kaieteur Savannas, *23137, 23143*.

ITHYCAULON INAEQUALE (Kunze) Copel. *Saccoloma inaequale* Mett. SURINAM: frequent at Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24114*.

LINDSAEA CORIIFOLIA Lindm. BRITISH GUIANA: on white sand, Kaieteur Savannas, *23394*. Identified from description and from the excellent illustrations of Lindman. The type was said, perhaps incorrectly, to have come from Caracas.

LINDSAEA CRENATA Klotzsch. BRITISH GUIANA: moist rock ledge, one mile below Kaieteur Falls, *23427*. SURINAM: frequent in damp soil in high bush, at base of north escarpment, Tafelberg, *24325*. As the specimens are sterile, the identification is somewhat uncertain. Not known previously from Surinam.

LINDSAEA DUBIA Spreng. SURINAM: terrestrial, frequent, vicinity of Krappa Camp (2), Saramacca River Headwaters, *24136;* below north escarpment, Tafelberg, *24315a;* along East Ridge Creek, Tafelberg, *24531*.

LINDSAEA FALCATA Dryander. SURINAM: frequent on forest floor, vicinity Black Water Camp (5), Coppenam River Headwaters, *24181;* trail from Savanna I to North Ridge, Tafelberg, *24244;* mixed high forest, slopes of Hill 2, between North Ridge and Augustus Creeks, Tafelberg, *24736*.

LINDSAEA LANCEA (L.) Bedd. BRITISH GUIANA: infrequent in mixed forest, Kamuni Creek, Essequibo River, *22917*.

LINDSAEA PARKERI Hook. BRITISH GUIANA: Kaieteur Savannas, *23413;* rare on moist rocks, Amatuk Portage, *23543*. SURINAM: frequent on mossy banks, lower Augustus Creek, Tafelberg, *24731*. A rare species not known previously from Surinam.

LINDSAEA PENDULA Klotzsch. BRITISH GUIANA: locally frequent in sedge bog, Kaieteur Savannas, *23160*.

LINDSAEA RENIFORMIS Dryander. SURINAM: frequent along stream borders on east side of North Ridge, Tafelberg, *24243;* frequent in boggy area along stream, 5 km. northwest of Savanna I, Tafelberg, *24817*. Posthumus regards this species as synonymous with *L. sagittata* (Aubl.) Dryander.

LINDSAEA STRICTA (Swartz) Dryander. BRITISH GUIANA: locally frequent in sedge bog, Kaieteur Savannas, *23159*. SURINAM: in wet places in thickets, Savanna IV, Tafelberg, *24377*.

[10] Contr. U. S. Nat. Herb. 17: 396. 1914.

LINDSAEA sp. BRITISH GUIANA: rare, Amatuk Portage, Potaro River Gorge, *23548*. The plants, which are nearly sterile, run to *L. falciformis* in Posthumus' key, but the venation does not agree very well with Hooker's illustration. That species is apparently known only from the original collection from Mount Roraima.

DIPLAZIUM LECHLERI (Mett.) Moore. SURINAM: terrestrial, rootstock horizontal-ascending, gelatinous, in high mixed forest at base of north escarpment, Tafelberg, *24303*. A distinctive species, not previously known from Surinam, but reported from British Guiana. It ranges from Costa Rica to Peru, but is everywhere rare.

ASPLENIUM ANGUSTUM Swartz. SURINAM: infrequent epiphyte, makapina-tete swamp, km. 13, Coppenam River Headwaters, *24852*.

ASPLENIUM AURITUM var. OBTUSUM (Kunze) Mett. SURINAM: frequent epiphyte in high forest, Arrowhead Basin, Tafelberg, *24479;* Augustus Falls, Tafelberg, *24753*. Listed by Posthumus as *A. sulcatum* Lam., which may be the proper specific epithet.

ASPLENIUM DIMIDIATUM Swartz. SURINAM: frequent terrestrial fern, high forest, in dense shade, below south escarpment of Arrowhead Basin, Tafelberg, *24506*. An extreme form referred here with misgiving. It differs from typical material of *A. dimidiatum*, of which an excellent series is at hand from the Greater Antilles, in its stout, densely scaly vascular parts, its more leathery texture, and in having the pinnae deeply excavate below, a condition not commonly seen in typical material, which has the pinnae merely dimidiate.

ASPLENIUM INTEGERRIMUM Spreng. SURINAM: epiphyte, Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24113*. So identified in accordance with Domin's streatment[11] of this variable group. Listed by Posthumus as *A. Kapplerianum.*

ASPLENIUM PEDICULARIIFOLIUM St. Hil. SURINAM: frequent on mossy rocks in dense shade below south escarpment of Arrowhead Basin, *24505a*. The specimen agrees very well with the original description and with a Brazilian specimen (locality not stated) in the New York Botanical Garden collected by Glaziou (No. 15740). Posthumus recorded this species from a single locality in Surinam (Brownsberg). It is a characteristic species without obvious relatives.

ASPLENIUM PERKINSII Jenm. SURINAM: on mossy rocks in dense shade, below south escarpment of Arrowhead Basin, Tafelberg, *24505*; Arrowhead Basin, Tafelberg, *24600a*. The first specimen cited is in substantial agreement with the rather poor type specimen at the New York Botanical Garden; the second is slightly more divided. The relationship is with *A. rutaceum* Mett. and *A. conquisitum* Underw. & Maxon. The status of these species should be reviewed in the light of the abundant material now avaiable.

ASPLENIUM SALICIFOLIUM L. SURINAM: frequent terrestrial fern among rocks and boulders, base of north escarpment, Tafelberg, *24304;* below south escarpment of Arrowhead Basin, Tafelberg, *24517*.

ASPLENIUM SERRA Langsd. & Fisch. SURINAM: infrequent, terrestrial fern in damp high bush, base of north escarpment, Tafelberg, *24331*.

ASPLENIUM SERRATUM L. SURINAM: frequent on moist rocks in montane forest, north slopes of Tafelberg, *25063*.

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[11] Pterid. Dominica 167. 1929.

BLECHNUM GRACILE Kaulf. SURINAM: frequent on moist rocks, north escarpment, Tafelberg, *24291;* Arrowhead Basin, Tafelberg, *24467, 24499.* The identification follows Posthumus. The group of *B. occidentale* L. is a complex one. Typical *B. occidentale* has blades with a regularly tapering apex and numerous pinnae, whereas *B. gracile* is essentially imparipinnate, the apex being elongate and subentire. Not previously reported from Surinam.

BLECHNUM INDICUM Burm. *B. serrulatum* L. C. Rich. SURINAM: savanna, vicinity of Sectie O, *25016.*

SYNGRAMMA sp. Two collections of this genus, one from Kaieteur Falls, *23430,* and one from Tafelberg, *24500,* will be discussed by the junior author in a separate paper in which the American species of *Syngramma* and *Pterozonium* will be treated. The presence of *Syngramma* on Tafelberg is of interest, since it shows clearly the relationship of the fern flora to that of Mount Roraima.

PITYROGRAMMA CALOMELANOS (L.) Link. BRITISH GUIANA: Kamuni Creek, Essequibo River, *22844.* Surinam: vicinity of Tawa Creek, Saramacca River, *23748;* base of north escarpment, Tafelberg, *24294*; vicinity of Sectie O, *25026.*

DORYOPTERIS SAGITTIFOLIA (Raddi) J. Smith. SURINAM: infrequent, on rocks in high mixed forest, Augustus Falls, Tafelberg, *24759.* An unusually large form.

ADIANTUM CAYENNENSE Willd. BRITISH GUIANA: frequent, terrestrial in dense second growth in windfall opening in heavy mora forest, Kamuni Creek, Essequibo River, *22858.* Considered as synonymous with *A. tetraphyllum* H.B.K. by Posthumus.

ADIANTUM DOLOSUM Kunze. BRITISH GUIANA: frequent, terrestrial in dense second-growth thickets, Kamuni Creek, Essequibo River, *22859.*

ADIANTUM LATIFOLIUM Lam. BRITISH GUIANA: frequent, along trail and in clearings, Kamuni Creek, Essequibo River, *22845;* Takutu Creek to Puruni River, Mazaruni River, *F2141.* SURINAM: along railroad, km. 70, *23065;* vicinity of Tawa Creek, Saramacca River, *23747.* No. 22845 has unusually small segments, but apparently must be referred here.

ADIANTUM PETIOLATUM Desv. SURINAM: frequent on river banks, Tafelberg Creek, Saramacca River Headwaters, *24077.*

ADIANTUM PULVERULENTUM L. SURINAM: frequent in deep shade of heavy bush on rocky slopes and river banks, Jacob kondre, Saramacca River Headwaters, *23827, 23828.*

ADIANTUM TERMINATUM Kunze. SURINAM: frequent in damp soil in high bush or mixed forest, base of north escarpment, Tafelberg, *24324, 24747.*

PTERIS ALTISSIMA Poir. *P. Kunzeana* Agardh. SURINAM: stem short, erect, in dense, damp high forest, vicinity of Augustus Falls, Tafelberg, *24743.*

PTERIS PUNGENS Willd. BRITISH GUIANA: Takutu Creek to Puruni River, Mazaruni River, *F2060, juvenile.* SURINAM: high bush, base of north escarpment, Tafelberg, *24342.*

VITTARIA FILIFOLIA Fée. SURINAM: on steep slopes in high forest, East Ridge Creek Gorge, Tafelberg, *24535.* Not previously recorded from Surinam.

VITTARIA LINEATA (L.) J. E. Smith. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River, *22872;* Mazaruni Station, *F2188.* SURINAM: pendent epiphyte, Charlesburg Rift, 3 km. north of Paramaribo, *22797;* maka-pina-tete swamp, Coppenam River Headwaters, *24851.*

VITTARIA REMOTA Fée. SURINAM: On rocks between Augustus and North Ridge Creeks, Tafelberg, *24188;* Arrowhead Basin, Tafelberg, *24463.*

HECISTOPTERIS PUMILA (Spreng.) J. Smith. SURINAM: common on moist cliff on base of north escarpment, Tafelberg, *24187.*

HECISTOPTERIS PUMILA var. **obtusa** Maxon & Morton, var. nov. A var. typica lobis foliorum obtusis vel rotundatis nec acuminatis differt.

TYPE: New York Botanical Garden. Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, Surinam, July 11, 1944, *Maquire 24101.* According to the notes on the label the plant is infrequent, growing mosslike on trees or fallen logs. A specimen in the National Herbarium collected at Pará by Spruce in 1849 may be the same. Christ[12] described three subspecies of *H. pumila* from Brazil, but all are invalid, being published as binomials in contravention of the International Rules.

POLYTAENIUM BRASILIANUM (Desv.) Benedict. SURINAM: Arrowhead Basin, Tafelberg, *24600.* The genus *Polytaenium* is included in *Antrophyum* by Posthumus.

POLYTAENIUM CAYENNENSE (Desv.) Benedict. BRITISH GUIANA: epiphyte growing on a rope. Takutu Creek to Puruni River, Mazaruni River, *F2155.*

COCHLIDIUM FURCATUM (Hook. & Grev.) C. Chr. BRITISH GUIANA: frequent, epiphytic or on wet rocks, Potaro River Gorge, *23484*, *23534.*

POLYPODIUM AUREUM L. BRITISH GUIANA: sandhills, Demerara River, *F1199.*

POLYPODIUM CACERESII Sodiro. BRITISH GUIANA: mossy rocks in high mixed forest on trail from Kaiatuk to Tukeit, *23478.* This species, which is a segregate of the widespread and variable *P. fraxinifolium* Jacq., has been previously known only from the Andes from Colombia to Bolivia. Mr. Weatherby has taken up for the species the name *P. articulatum* Desv., but that is a homonym of the earlier *P. articulatum* Juss. However, an earlier name among the many putative synonyms of *P. fraxinifolium* may be available.

POLYPODIUM CILIATUM Willd. SURINAM: common epiphyte, White Rock Rapids, Saramacca River, *24003;* savanna, Zanderij I, *25048.*

POLYPODIUM DUALE Maxon. BRITISH GUIANA: Amatuk Portage, Potaro River Gorge, *23029;* trail from Kaiatuk to Tukeit, *23480.* SURINAM: north escarpment, between Augustus and North Ridge Creeks, Tafelberg, *24186;* 2 km. south of East Ridge, Tafelberg, *24580;* Arrowhead Basin, Tafelberg, *24464.*

POLYPODIUM FLAGELLARE Christ. SURINAM: infrequent epiphyte in high forest, at base of south escarpment, Arrowhead Basin, Tafelberg, *24478.* The specimen agrees excellently with a series from Panama. A photograph and fragment show that the type (from Surubris, near San Mateo, Costa Rica, *Biolley 2671*) has somewhat narrower pinnae, Not previously reported from Surinam.

POLYPODIUM LYCOPODIOIDES L. var. SALICIFOLIUM (Willd.) Bonap. BRITISH GUIANA: frequent epiphyte, Kamuni Creek, Groete Creek, Essequibo

[12] Hedwigia 44: 366. 1905.

River, *22820;* Mazaruni Station, *F2190.* This is the plant called *P. surinamense* Jacq. by Posthumus, but that should probably be kept as a dubious species. Lindman[13] identified it with a species of Brazil, Uruguay, Paraguay, and Argentina, distinguished from the present plant by its paleaceous frond and other characters. This southern species, which is not known to occur in the Guianas, should be called *P. squamulosum* Kaulf., the name in common use. Jacquin's plate and description call for a plant with serrulate fronds, a character not in accord with either *P. lycopodioides* or *P. squamulosum.* From typical West Indian *P. lycopodioides* the variety *salicifolium* is distinguished primarily by its more prominent venation.

POLYPODIUM MOLLISSIMUM Fée. SURINAM: base of north and south escarpments, Tafelberg, *24498, 24752.* Not previously reported from Surinam, but specimens may have been confused with the related *P. cultratum* Willd.

POLYPODIUM NANUM Fée. SURINAM: infrequent on moss-covered rocks in high mixed forest at base of north escarpment, Augustus Falls, Tafelberg, *24771.* A widespread but uncommon South American species, not previously reported from Surinam.

POLYPODIUM PANORENSE C. Chr. BRITISH GUIANA: on rocks in mixed forest, trail from Tukeit to Kaieteur Plateau, Potaro River Gorge, *23084.* Identified from description. The type was collected by Spruce (No. 2324) at Panuré, on Río Vaupes, Colombia. It was collected also by Mr. A. Roman at Taracuá, on Río Vaupes.

POLYPODIUM PERCUSSUM Cav. SURINAM: locally common epiphyte, White Rock Rapids, Saramacca River, *24006;* Augustus Falls, Tafelberg, *24755;* Savanna I, Tafelberg, *24400.*

POLYPODIUM PERSICARIIFOLIUM Schrad. SURINAM: frequent epiphyte, White Rock Rapids, Saramacca River, *24004.*

POLYPODIUM PHYLLITIDIS L. SURINAM: frequent terrestrial or epiphytic fern, Saramacca River banks above Kwatta hede, *23937;* Gran dam Rapids, Saramacca River, *24012;* Arrowhead Basin, Tafelberg, *24495;* savanna, Zanderij I, *25045.*

POLYPODIUM PLUMULA Humb. & Bonpl. SURINAM: epiphytic or terrestrial, White Rock Rapids, Saramacca River, *24005;* base of north escarpment, Tafelberg, *24754;* Grasi Falls, Saramacca River, *24945.* As currently interpreted this is a widespread and variable species (doubtless an aggregate), listed by Posthumus as *P. hygrometricum* Splitg.

POLYPODIUM POLYPODIOIDES (L.) Watt. var. BURCHELLII (Baker) Weatherby. SURINAM: Jacob kondre, Saramacca River, *23891.* Infrequent in the Guianas.

POLYPODIUM REPENS Aubl. SURINAM: frequent in dense shade of high forest below south escarpment of Arrowhead Basin, Tafelberg, *24507.*

POLYPODIUM TAENIFOLIUM Jenm. SURINAM: epiphyte, southeast of Savanna VIII, Tafelberg, *24567, 24633.* Identified with doubt. This species was described originally from Jamaica, where it is rare, and is known also from Hispaniola. It is abundant in Puerto Rico, the Lesser Antilles, and Trinidad, but has not previously been reported from the Guianas.

POLYPODIUM TAXIFOLIUM L. SURINAM: frequent epiphyte, 1 km. east of

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[13] Ark. Bot. 1: 247. 1903.

Savanna VIII, Tafelberg, *24568*. A notable extension of range, this species having previously been known from Hispaniola, Puerto Rico, and the Lesser Antilles. It has been erroneously reported from the Andes.

POLYPODIUM TECTUM Kaulf. SURINAM: locally common epiphyte, White Rock Rapids, Saramacca River, *24002*.

POLYPODIUM TRISERIALE Swartz. *P. brasiliense* Poir. BRITISH GUIANA: sandy soil, Kaieteur Savannas, *23138;* Potaro River Gorge, *23527,* depauperate.

POLYPODIUM sp. SURINAM: frequent epiphyte along streams, east side of North Ridge, Tafelberg, *24239*. We have been unable to identify this with any described species.

ESCHATOGRAMME DESVAUXII (Klotzsch) C. Chr. BRITISH GUIANA: infrequent epiphyte, Kamuni Creek, Groete Creek, Essequibo River, *22849*. SURINAM: maka-pina-tete swamp, Coppenam River Headwaters, *24850*. Included in *E. furcata* (L.) C. Chr. by Posthumus.

ELAPHOGLOSSUM GLABELLUM J. Smith. BRITISH GUIANA: one mile below Kaieteur Falls, *23439*. SURINAM: White Rock Rapids, Saramacca River, *24001*.

ELAPHOGLOSSUM PLUMOSUM (Fée) Moore. SURINAM: frequent epiphyte on tree trunks in low bush, near north escarpment, Tafelberg, *24185*. Identified by the description and plate of Fée.

ELAPHOGLOSSUM RIGIDUM (Aubl.) Urban. *Acrostichum flaccidum* Fée. SURINAM: frequent on damp rocks at base of north escarpment, Tafelberg, *24332*.

ELAPHOGLOSSUM SCHOMBURGKII (Fée) Moore. SURINAM: terrestrial, leaves glossy, frequent in high, moist, boulder-strewn, somewhat open forest below south escarpment of Arrowhead Basin, Tafelberg, *24516*. This species is little known. The identification needs verification by comparison of the specimen with authentic material.

ELAPHOGLOSSUM SPATHULATUM (Bory) Moore. SURINAM: frequent on moss-covered rocks in high forest, Grace Falls, Tafelberg, *24511*.

PARKERIACEAE

CERATOPTERIS PTERIDOIDES (Hook.) Hieron. SURINAM: frequent in marshes along jungle border, Charlesburg Rift, 3 km. north of Paramaribo, *22719*. Included erroneously in the Old World species *C. thalictroides* (L.) Brongn. by Posthumus, who apparently overlooked Dr. Benedict's work on this genus.

GLEICHENIACEAE

DICRANOPTERIS REMOTA (Kaulf.) Maxon. BRITISH GUIANA: erect, spreading fern in exposed lateritic soil, Bartica-Potaro, *F1096;* climber on rock faces and banks along road, Garraway Stream, Potaro River, *22984*. Apparently included by Posthumus in *Gleichenia furcata* (L.) Spreng.

SCHIZAEACEAE

ACTINOSTACHYS PENICILLATA (Humb. & Bonpl.) Maxon. *Schizaea subtrijuga* Mart. BRITISH GUIANA: dry, sandy, open places, one mile below Kaieteur Falls, *23441*.

ACTINOSTACHYS PENNULA (Swartz) Hook. BRITISH GUIANA: locally

frequent in shallow sand or on open dry rocks, Potaro River Gorge, *23518*. SURINAM: Savanna IV, Tafelberg, *24376*, *24394a*; south savannas, vicinity Arawak village of Mata, Zanderij, *24976*.

SCHIZAEA ELEGANS (Vahl) Swartz var. FLABELLUM (Mart.) Prantl. BRITISH GUIANA: rare or infrequent, terrestrial on steep slopes in high mixed forest, Kaieteur Savannas, *23189*. SURINAM: East Ridge Creek Gorge, Tafelberg, *24534*; Arrowhead Basin, Tafelberg, *24613*; dense high bush north of Savanna II, Tafelberg, *24280*, *25070*.

SCHIZAEA INCURVATA Schkuhr. BRITISH GUIANA: Kaieteur Savannas, *23251*. Surinam: grass savanna, Zanderij II, *23668*; Arawak village, Zanderij, *24975*.

LYGODIUM VOLUBILE Swartz. SURINAM: frequent, railroad near km. 70, Sectie O, *23615*; base of north escarpment, Tafelberg, *24295*. A collective species, here regarded in the inclusive sense of Posthumus.

MARATTIACEAE

DANAEA SIMPLICIFOLIA Rudge. SURINAM: infrequent on wet walls of cataract, lower North Ridge Creek, Tafelberg, *24812*. The leaves are relatively a good deal narrower than those of most of the specimens in the National Herbarium.

OPHIOGLOSSACEAE

OPHIOGLOSSUM ELLIPTICUM Hook. & Grev. SURINAM: Locally frequent in sand pocket, Gran dam, Saramacca River, *24926*. Identified by Dr. Robert T. Clausen.

LYCOPODIACEAE

LYCOPODIUM MERIDIONALE Underw. & Lloyd. BRITISH GUIANA: frequent in sedge bog, Kaieteur Savannas, *23111*. SURINAM: frequent, damp sand, Zanderij II, *23690*; frequent, savanna, Zanderij I, vicinity Arawak village Mata, *24981*. Broadly distributed in the American tropics. (Identified by Bassett Maguire.)

LYCOPODIUM CERNUUM L. BRITISH GUIANA: banks, Garraway Stream, Potaro River, *22969*. SURINAM: frequent, railway embankment and ditch bank, km. 70, Sectie O, *23627*; km. 68, *25071*. Broadly distributed in tropical America, extending northward to Florida and Mississippi. (Determined by Bassett Maguire.)

ISOËTACEAE

ISOËTES OVATA Pfeiffer. BRITISH GUIANA: common, buried in sand to 10 cm. deep in river tidal flats, vicinity of Mazaruni Forest Station, *23569*; moist sand between rocks, Takutu Creek to Puruni River, Mazaruni River, *F2093*. Known only from the Mazaruni River. (Identified by Bassett Maguire.)

SELAGINELLACEAE[14]

SELAGINELLA PEDATA Klotzsch. SURINAM: common in clearings, openings in deep wallaba forest, vicinity Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24104*. British Guiana, Brazil.

SELAGINELLA EPIRRHIZOS Spring. BRITISH GUIANA: common in moist places, thickets, high mixed forest, Kamuni Creek, Groete Creek, Essequibo

[14] By A. H. G. Alston.

River, *22847;* creeping perennial, adventitious roots, Kamuni Creek, Groete Creek, Essequibo River, *F1821* (determined by Bassett Maguire); Takutu Creek to Puruni River, Mazaruni River, *F2033;* abundant on damp lateritic soil by roadside, *F1189* (determined by Bassett Maguire). British and French Guiana, Brazil.

SELAGINELLA FLAGELLATA Spring. BRITISH GUIANA: common, rock surfaces along small streams, low forest, Kaieteur Plateau, *23416.* SURINAM: infrequent, wet mossy rocks and walls, base of north escarpment, Tafelberg, *24336;* abundant on dripping walls, base of north escarpment, Tafelberg, *24337;* frequent, wet mossy cliff base, Augustus Falls, Tafelberg, *24772;* frequent, moist rocks, east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24553.* British and French Guiana, Brazil, Trinidad, Venezuela, Colombia and Central America.

SELAGINELLA REVOLUTA Bak. BRITISH GUIANA: on rock face and at base of rock, Garraway Stream, Potaro River, *22971.* French and British Guiana, Northern Brazil, Venezuela, Colombia, Peru.

SELAGINELLA PRODUCTA Bak. BRITISH GUIANA: occasional, moist rocks, mixed forest, trail from Tukeit to Kaieteur Plateau, *23089;* marsh forest, Sebai Creek, Kaituma River, *F2417.* SURINAM: frequent, moist, soil, on rocks, opening in high bush, base north escarpment, Tafelberg, *24316.* New for Surinam.

SELAGINELLA DENDRICOLA Jenm. SURINAM: infrequent, moist rocks, high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24497.* New for Surinam.

SELAGINELLA PARKERI (Hook. & Grev.) Spring. BRITISH GUIANA: in riparian forest, Takutu Creek to Puruni River, Mazaruni River, *F2121.* SURINAM: frequent, wet walls cataract, lower North Ridge Creek, Tafelberg, *24813;* frequent, high mixed forest, below cliffs of west escarpment, Tafelberg, *24696;* frequent, montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24142.* Not in the Selaginellaceae of Surinam.[15]

SELAGINELLA MAZARUNIENSIS Jenm. BRITISH GUIANA: 40–50 cm., moist rocks, one mile below Kaieteur Falls, Potaro River Gorge, *23425;* occasional to frequent, repent on rocks, Amatuk Portage, *23024.*

SELAGINELLA POTAROENSIS Jenm. BRITISH GUIANA: occasional, repent on moist rocks, under dripping water, mixed forest, trail from Tukeit to Kaieteur Plateau, *23083.*

SELAGINELLA VALDEPILOSA Bak. BRITISH GUIANA: frequent, rock surfaces along streams, low forest, Kaieteur Plateau, *23415.*

SELAGINELLA TUBERCULATA Spruce. SURINAM: wet rocks, high bush, base of north escarpment, Tafelberg, *24339a.* New for Surinam.

GNETACEAE

GNETUM NODIFLORUM Brongn. SURINAM: infrequent, high-climbing liana, ♂, overhanging river, mixed primary forest, vicinity Jacob kondre, Saramacca River, *23861;* unicate, ♂, only specimen seen, apparently parasitic in the top of tall trees, mixed forest, hill 1.5 km. northeast of Savanna III, Tafelberg, *24716.* Forest areas, more conspicuous along rivers, British Guiana to Pará, Brazil.

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[15] *Flora of Suriname,* vol. 1, part 1. 1938.

GNETUM PANICULATUM Spruce. BRITISH GUIANA: rope from tree crown, leaves stiff and brittle, ♂, Barabara Creek, 14 mi. Bartica-Potaro Road, *F823;* 12 cm. diameter, soft brown, finely scaly rope with sticky whitish latex, ♂, Black Creek, Groete Creek, Essequibo River, *F1789.* In the above specimens, the panicles are paired in leaf axils and are much shorter than in *G. paniculatum.* They might well represent a distinct species.

TYPHACEAE

TYPHA DOMINGENSIS Pers. BRITISH GUIANA: perennial herb, pegass swamp, Mabaruma, Aruka River, N. W. D., *F2392.* SURINAM: common, marshes along Saramacca River, vicinity Carl Francois, *23597.* Generally distributed in the American tropics and southern United States.

ALISMACEAE[16]

SAGITTARIA LANCIFOLIA L.[17] BRITISH GUIANA: marsh herb to 2 m. high, vicinity Mazaruni Forest Station, sandy foreshore, river tidal flats, *23569.* Known from the southern United States, West Indian Islands, Central America and tropical South America.

BUTOMACEAE

HYDROCLEIS NYMPHOIDES (Willd.) Buchenau. SURINAM: flowers buff-colored, floating in water to 2 m. deep, locally common, canal 60 km. from Paramaribo on the Carl Francois road, *23590.* Widespread in tropical South America.

GRAMINEAE[18]

ERAGROSTIS CILIARIS (L.) Link. SURINAM: frequent, sand banks along railroad bed, Kwakoegron, *23776.* Common weedy grass, occurring throughout the warmer regions of the world.

ERAGROSTIS GLOMERATA (Walt.) L. H. Dewey. BRITISH GUIANA: open savanna, Rupununi District, *Fraser 351.* West Indies; Venezuela to Bolivia and Argentina. This is the first record for British Guiana of a common rather wide-spread species.

ERAGROSTIS MAYPURENSIS (H.B.K.) Steud. BRITISH GUIANA: white sand, Waratuk Falls, Potaro River Gorge, *23049.* Southern Mexico to Brazil and Bolivia.

STEIRACHNE DIANDRA Ekman. BRITISH GUIANA: slender tufted grass of moist or dry sandy places, Rupununi, *Fraser 358.* This is the first record for British Guiana. Venezuela, British Guiana, and Northeastern Brazil.

STREPTOGYNE CRINITA Beauv. SURINAM: frequent, conspicuous with elongate blades and mature fruits hanging by the elongate entangled stigmas, forest floor, trail to Coppenam River, rear of village, Pakka Pakka, *23975.* Wet forests, Mexico, Guatemala, Panamá, Trinidad, Surinam, and northern Brazil.

ORTHOCLADA LAXA (L. Rich.) Beauv. BRITISH GUIANA: roadside grass on lateritic gravelly soil, Mabaruma, Aruka River, *F2355.* A woodland grass with long, fine, readily disarticulating panicle branches and relatively broad petiolate blades. Mexico to Brazil and Peru.

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[16] By F. P. Jonker.

[17] Pulle, Fl. Suriname 1: 481. 1943.

[18] By Jason R. Swallen.

SPOROBOLUS INDICUS (L.) R.Br. SURINAM: frequent, open sandy areas, shrub savanna, Charlesburg Rift, 3 km. north of Paramaribo, *22753*. Mexico and the West Indies to Colombia and Brazil.

CHLORIS RADIATA Swartz. BRITISH GUIANA: New Amsterdam Berbice, *Fraser 356*. Mexico and the West Indies to Bolivia and Argentina.

TRICHACHNE INSULARIS (L.) Nees. SURINAM: frequent, open sandy areas, shrub savanna, Charlesburg Rift, 3 km. north of Paramaribo, *22754*. Southern United States and the West Indies to Argentina.

DIGITARIA ARGILLACEA (Hitchc. & Chase) Fern. BRITISH GUIANA: small tufted annual with few rather dense ascending racemes, Rupununi, *Fraser 363*. The first record for British Guiana. Mexico and the West Indies to Colombia and British Guiana.

ECHINOLAENA INFLEXA (Poir.) Chase. SURINAM: creeping grass with thick reflexed racemes, grass-sedge savanna, Zanderij II, *25042*. Venezuela, Colombia, British and French Guiana and Brazil.

MESOSETUM LOLIIFORME (Hochst.) Chase. BRITISH GUIANA: occasional locally, tufted or stoloniferous with solitary whitish racemes, gravelly soil, Kaieteur Savanna, *23448*. Campos and open sandy woods, Cuba, Trinidad; Venezuela to eastern Brazil.

REIMAROCHOLA ACUTA (Flugge) Hitchc. BRITISH GUIANA: a widely spreading stoloniferous grass, forming dense mats on moist soil on river banks and lake shores, Rupununi, *Fraser 360*. This is the first collection from British Guiana. Venezuela, British Guiana, Brazil, and Paraguay.

AXONOPUS CAULESCENS (Mez) Henr. SURINAM: abundant, joints in bed rock, Savanna I, Tafelberg, *24816*. Described from Mt. Roraima, the only other locality known for this species,

Axonopus flabelliformis Swallen, sp. nov. Perennis; culmi dense caespitosi, erecti, 65 cm. alti, compressi, glabri; vaginae elongatae, equitantes, approximatae, basi 4–5 mm. latae, glabrae; laminae 9–15 cm. longae, 6–8 mm. latae, glabrae; inflorescentiae terminales et axillares; racemi 11–12, adscendentes, 8–10 cm. longi, rhachibus 0.5 mm. latis basi dense pubescentibus marginibus minute scabris; spiculae glabrae 1.6 mm. longae; gluma secunda hyalina obtusa, nervo medio obsoleto; lemma sterile late acutum fructum aequans; fructus flavo-brunneus.

Perennial; culms erect in large clumps, 65 cm. high, compressed, glabrous, the lower part completely covered by the crowded equitant leaves; sheaths strongly compressed, elongate, glabrous, 4–5 mm. or more wide toward the base, the junction with the blade obscure but evident from the outside; blades 9–15 cm. long, those of the lower outer sheaths shorter, conduplicate, 3–4 mm. wide as folded, glabrous, the tip navicular; inflorescences terminal and sometimes axillary; racemes 11–12, rather narrowly ascending, 8–10 cm. long, distributed on the axis 3–4 cm. long, the rachis 0.5 mm. wide, narrowly winged, densely pubescent at the base, the margins and keel between the rows of spikelets minutely scabrous; spikelets 1.6 mm. long, pale; second glume and sterile lemma thin, the glume obtuse, shorter than the fruit, the midnerve suppressed, the lemma broadly acute, as long as or slightly longer than the fruit, weakly nerved; fruit light brown at maturity.

Type: in sandy soil, Half-way station between Wismar and Rockstone, Demerara River, British Guiana, *Hitchcock 17275*.

This species has been referred to *Axonopus attenuatus* (Presl) Hitchc. The latter was described from the province of Huanuco, Peru, and differs in several respects. A photograph of the type does not show the conspicuous equitant sheaths of our species, the rachis is scarcely 3 mm. wide, and the spikelets are 2 mm. long with the second glume and sterile lemma equal, pointed beyond the fruit.

F2503 also belongs to *A. flabelliformis*, although the plant is taller and coarser than the type, with 29 racemes as much as 13.5 cm. long. The spikelets are identical.

Axonopus kaietukensis Swallen, sp. nov. Perennis; culmi dense caespitosi, erecti 75–95 cm. alti, paulo compressi, carinati, marginibus dense villosis vel papilloso-villosis; ligula pilosa brevissima; laminae conduplicatae, 15–20 cm. longae, inferiores et superiores reductae, 6 mm. latae, glabrae, marginibus scabris basi dense ciliatis; racemi 8–18, adscendentes, 9–14 cm. longi basi dense pubescentes; spiculae 2 mm. longae, pallidae, ei *A. flabelliformi* similes.

Perennial; culms densely tufted, erect, 75–95 cm. high, somewhat compressed, glabrous; sheaths broad, strongly compressed, keeled, densely villous or papillose-villous on the margins, the junction with the blade not at all evident from outside; ligule a dense line of very short hairs; blades strongly conduplicate, 15–20 cm. long (except the lower ones and the uppermost which are considerably reduced), 3 mm. wide as folded, glabrous on the back, the margins scabrous, densely ciliate toward the base; inflorescences terminal and axillary from the upper sheath; racemes 8–18, rather slender, ascending, 9–14 cm. long, densely pubescent at the base, distributed on the axis 3–5 cm. long, the lowest raceme distant from the others; spikelets 2 mm. long, pale; second glume and sterile lemma thin, almost hyaline, the glume obtuse, slightly shorter than the fruit, the mid-nerve suppressed, the lemma equaling the fruit, acutish; fruit light brown.

TYPE: on dry rocky ground, Kaieteur Savannas, British Guiana, May 14, 1944, *Maguire & Fanshawe 23154*. Known only from the Kaieteur Savannas, and probably endemic. *Tutin 621*, collected in "sandy places with scattered bushes" is the only other specimen known.

This species resembles the preceding but differs in having larger spikelets, longer blades, and shorter sheaths, the latter densely villous on the margins.

Axonopus purpurellus Swallen, sp. nov. Perennis; culmi erecti circa 1 m. alti, paulo compressi, glabri; vaginae carinatae, internodiis longiores, glabrae, marginibus hyalinis; laminae basi conduplicatae, 20–30 cm. longae, 6 mm. latae, scaberulae, marginibus scabris, basi sparse papilloso-ciliatis; racemi 18, angusta adscendentes, rhachibus 0.8 mm. latis, basi minute pubescentibus marginibus scabris; spiculae 1.8 mm. longae, purpurellae, glabrae; gluma et lemma sterile aequalia fructu paulo longiora, sub-acuta; fructus fuscus.

Perennial; culms erect, about 1 m. tall, somewhat compressed, glabrous; sheaths keeled but not strongly compressed, rather loose, longer than the internodes but not crowded, glabrous, the margins hyaline; blades conduplicate, becoming flat, mostly 20–30 cm. long, 3 mm. wide as folded, very gradually narrowed from the base, scaberulous, the margins scabrous, sparsely papillose ciliate at the base; racemes 18, narrowly ascending, the

rachis 0.8 mm. wide, scabrous on the margins, minutely pubescent at the base; spikelets 1.8 mm. long, purplish, glabrous, the second glume and sterile lemma equal, covering the fruit, thin but not hyaline, the mid-nerve of the glume suppressed, of the lemma rather prominent; fruit chestnut brown.

TYPE: on wet sandy soil, km. 68, vicinity of Sectie O, Surinam, October 19, 1944, *Maguire & Stahel 24997*.

Related to the two preceding species, differing in the second glume and sterile lemma being equal, covering the fruit, longer blades which become flat, and the looser, less crowded sheaths. Known only from the type collection.

Paspalum axillare Swallen, sp. nov. Annuum; culmi valde graciles, decubentes, 20–40 cm. longi; vaginae plerumque internodiis breviores, glabrae; ligula 0.5–1 mm. longa, truncata; laminae flaccidae, 4–11 cm. longae, 1–2.5 mm. latae, glabrae; racemus 2.5–3.5 cm. longus, solitarius terminalis et axillaris, pedunculo elongato filiformi, rhachi alata 0.5–0.6 mm. lata; spiculae 1–1.1 mm. longae solitariae pedicellis brevibus scabris; gluma secunda obsoleta; lemma sterile hyalinum, 3-nerve; fructus 1 mm. longus, obovatus, albus, minute striatus.

Weak, very slender annual; culms 20–40 cm. long, decumbent spreading, more or less geniculate at the nodes; sheaths except the lowermost, shorter than the internodes, glabrous, the uppermost bladeless; ligule 0.5–1 mm. long, brownish, truncate; blades lax, 4–11 cm. long, 1–2.5 mm. wide, glabrous; racemes solitary, terminal and axillary from all but the lowermost sheath, borne on elongate filiform peduncles, 2.5–3.5 cm. long, the rachis winged, 0.5–0.6 mm. wide, terminating in a spikelet; spikelets 1–1.1 mm. long, solitary, not crowded, on short scabrous pedicels; first glume wanting; second glume wanting or reduced to a very short nerveless scale; sterile lemma hyaline, very weakly 3-nerved, as long as the fruit; fruit 1 mm. long, slightly obovate, white, very minutely striate.

TYPE: in sand along ledge, moist base of wall, west escarpment, Tafelberg, Surinam, September 10, 1944, *Maguire 24678*.

Belonging to the *Ceresia* group, *P. axillare* differs from all the others in the delicate culms and solitary racemes, these terminal and usually axillary from all but the lowermost sheaths.

Paspalum lucidulum Swallen, sp. nov. Perenne; culmi erecti vel adscendentes, 65 cm. alti, ramosi, compressi, glabri; vaginae carinatae, internodia aequantes, glabrae, marginibus dense ciliatis; ligula truncata 1.5 mm. longa; laminae 15–25 cm. longae, 9–12 mm. latae, acuminatae, lucidulae, sparse pilosae ad basim contractae, supremae reductae; racemi 1 vel 2, arcuati, rhachi alata 1 mm. lata; spiculae obovatae, 2.0–2.1 mm. longae, binae, glabrae; gluma prima 0.4 mm. longa, obtusa vel truncata, enervis; gluma secunda obtusa, 5-nervis, fructum aequans; lemma sterile fructu paulo longior 5-nerve; palea hyalina explicata; fructus 2 mm. longus, obovatus, minute striatus.

Perennial, culms erect or ascending, 65 cm. high, compressed, glabrous, sparingly branched from the upper nodes; sheaths compressed, keeled, glabrous, rather densely ciliate on the margins, about as long as the internodes; ligule brown, truncate, 1.5 mm. long; blades 15–25 cm. long, rather thin, shining, acuminate, sparsely pilose below, sparsely papillose-hispid

above, those of the mid-culm narrowed toward the base to the width of the sheath, the upper blades rounded, somewhat clasping at the base, the uppermost ones much reduced; inflorescence terminal and axillary from the upper sheath, the peduncle 4–6 cm. long, bearing 1 or 2 arcuate racemes, the rachis narrowly winged, about 1 mm. wide; spikelets 2.0–2.1 mm. long, obovate, glabrous, paired, the lower of each pair short-pedicellate, the upper with a pedicel 1 mm. long; first glume present on all spikelets, all alike, 0.4 mm. long, broadly rounded or truncate, nerveless; second glume broadly obtuse, 5-nerved, just covering the fruit and somewhat clasping it; sterile lemma slightly longer than the fruit, 5-nerved, the margins near the summit incurved forming a small hood, the palea well developed, thin, fitting into the incurved margins of the fruit, but without a staminate flower; fruit 2 mm. long, elliptic-obovate, minutely striate.

TYPE: on wet rocky slopes in spray of Grace Falls, Arrowhead Basin, Tafelberg, Surinam, August 26, 1944, *Maguire 24492*.

Related to *P. altsoni* Chase, which differs in having smaller spikelets 1.8 mm. long, and long attenuate blades gradually narrowed toward the base.

PASPALUM PULCHELLUM Kunth. SURINAM: frequent, grass-sedge area, Savanna VI, Tafelberg, *24785*. West Indies; Guatemala to Brazil.

PASPALUM PARVIFLORUM Rohdé. SURINAM: frequent, annual, Savanna II, Tafelberg, *24226*. Puerto Rico; Panamá to Brazil.

PASPALUM LINEARE Trin. BRITISH GUIANA: densely tufted, with short paired racemes of rather large spikelets, Rupununi, *Fraser 355*. This is the first record for this species in British Guiana; also in Brazil and Paraguay.

PASPALUM PLICATULUM Michx. BRITISH GUIANA: Ebeni Experiment Station, *Fraser 365*. Common, southeastern United States and the West Indies to Argentina, although otherwise known in British Guiana only from the Pacaraima Mountains.

PASPALUM MELANOSPERMUM Desv. BRITISH GUIANA: annual, decumbent, more or less weedy grass, in aspect similar to the preceding, Rupununi, *Fraser 361*. Colombia, British and French Guiana, and northern Brazil.

PASPALUM GARDNERIANUM Nees. BRITISH GUIANA: Rupununi, *Fraser 357*. A rather common species on Brazilian grasslands, known elsewhere in British Guiana only from Mt. Roraima; also in Venezuela and Paraguay.

PASPALUM SCANDENS Tutin. BRITISH GUIANA: local, introduced weed, vicinity resthouse, Kaieteur Savannas, *23456* (identified by F. J. Hermann).

PANICUM FASCICULATUM Swartz. BRITISH GUIANA: common widespread weedy grass, with small dark brown spikelets, New Amsterdam Berbice, *Fraser 359*. Southern United States and the West Indies to Ecuador and Brazil.

PANICUM MOLLE Swartz. BRITISH GUIANA: foliage velvety, the spikelets purple, glabrous, a weedy species, Rupununi, *Fraser 364*. Mexico and the West Indies to Argentina.

PANICUM TATEI Swallen. *P. tropidoblephare* Tutin. BRITISH GUIANA: abundant, stiffly erect, with long rigid pungent blades, dominant savanna grass, Kaieteur Savannas, *23399*. Venezuela and British Guiana.

PANICUM PILOSUM Swartz. BRITISH GUIANA: infrequent, in moist soil with sedges, in opening in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22894*. Surinam: locally frequent, joints in bed rocks, Augustus Falls, Tafelberg, *24764*. Mexico and the West Indies to Brazil.

PANICUM LAXUM Swartz. BRITISH GUIANA: locally frequent, in damp sand, Kaieteur Savannas, *23242;* local weed, vicinity of resthouse, Kaieteur Savanna, *23457*. Surinam: along Augustus Creek, Table Mountain, *24735a*. Mexico and the West Indies to Paraguay.

PANICUM FRONDESCENS Meyer. BRITISH GUIANA: frequent, decumbent spreading grass, the culms rooting at the nodes, with sedges in moist soil, in opening in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22893;* swampy ground, Mazaruni Station, *F782*. Mexico to Bolivia and Argentina.

PANICUM STOLONIFERUM Poir. BRITISH GUIANA: river bank between Kangaruma and Amatuk, Potaro River, *23008*. SURINAM: frequent, dense shade, low bush, bordered by *Montrichardia arborescens* and sparse *Drepanocarpus lunatus*, vicinity of Tawa Creek, Saramacca River, *23741*. Mexico to Ecuador and Brazil.

PANICUM NERVOSUM Lam. SURINAM: common, coarse low grass with closely overlapping sheaths and appressed subcordate blades, savanna, Zanderij I, *23722;* wet places, grass-sedge area, Savanna IV, Tafelberg, *24381*. British Guiana, Surinam, and northern Brazil.

PANICUM MICRANTHUM H.B.K. SURINAM: frequent, grass savanna, Zanderij II, *23659*. Venezuela, British Guiana, and Surinam.

Panicum spissifolium Swallen, sp. nov. Perenne; culmi 15–28 cm. alti, erecti vel adscendentes, ramosi, foliosi; vaginae internodiis breviores, glabrae vel sparse pilosae; ligula truncata, 0.3–0.4 mm. longa; laminae erectae 2–3 cm. longae, 2–3.5 mm. latae, plerumque pilosae, vel subtus glabrae; panicula 3–6 cm. longa, ramis adscendentibus vel patentibus; spiculae 1.2 mm. longae, subglobosae, glabrae, purpureae; gluma prima subobtusa quam spicula duplo brevior; gluma secunda obtusa quam spicula paulo brevior; lemma sterile quam spicula paulo longior.

Perennial; culms densely tufted, erect or ascending, 15–28 cm. tall, rather freely branching from the lower nodes, forming a dense mass of foliage at the base of the plant, the lower internodes short, the upper ones longer; sheaths glabrous or sparsely pilose toward the summit, sometimes overlapping but usually shorter than the internodes, the upper ones much shorter than the internodes; ligule hyaline, truncate, about 0.3–0.4 mm. long; blades erect or nearly so, 2–3 cm. long, 2–3.5 mm. wide, bluish-green, glabrous beneath or usually rather conspicuously long-pilose on both surfaces, with prominent white cartilaginous margins; panicles 3–6 cm. long, as broad as long, with slender ascending to spreading branches; spikelets subspherical, purple, glabrous, 1.2 mm. long, on long, very slender divergent pedicels; first glume sub-obtuse, about half as long as the spikelet; second glume obtuse, a little shorter than the fruit; sterile lemma obtuse, slightly longer than the fruit.

TYPE: on rocks in white sand from conglomerate and sandstone, Kaieteur Savannas, British Guiana, April 30, 1944, *Maguire & Fanshawe 23097*.

This species is related to *Panicum micranthum* H.B.K. which differs in having longer acuminate glabrous blades and a lanceolate ligule 1.5 mm. long.

Also referable to this species is *23097a*, which differs only in having taller somewhat more slender culms, with the blades scattered along the culm rather than crowded toward the base.

PANICUM POLYCOMUM Trin. BRITISH GUIANA: locally frequent, small tufted grass, creek bank, Kaieteur Savannas, *23241*. SURINAM: grass savanna, Zanderij II, *23643;* joints in rocky stream bed, Augustus Creek, Tafelberg, *24649*. Venezuela, Colombia, and British Guiana.

PANICUM KAIETUKENSE Tutin. BRITISH GUIANA: locally abundant, erect to decumbent-spreading, with ascending to reflexed blades, in pool 16 cm. deep, with sphagnum, Kaieteur Savanna, *23306*. Described from the Kaieteur Savanna (*Tutin 688*, type); this is the only known collection except the type.

Panicum arctum Swallen, sp. nov. Annuum; culmi graciles erecti, ramosi, 15–30 cm. alti; vaginae internodiis breviores, glabrae vel sparse pilosae; ligula truncata, circiter 0.5 mm. longa; laminae appressae, 3–4.5 cm. longae, 2–3 mm. latae, glabrae, marginibus minute scabris; panicula 4–10 cm. longa, 1–3 cm. lata, ramis filiformibus adscendentibus; spiculae 1.2 mm. longae, glabrae; gluma prima angusta, obtusa, quam spicula duplo brevior; gluma secunda late obtusa, 3-nervis, quam spicula brevior; lemma sterile quam fructu paulo longior, minute apiculatum; fructus 1 mm. longus, lucidus.

Slender annual; culms 15–30 cm. tall, erect or somewhat spreading, rather freely branching from the lower and middle nodes, glabrous; sheaths all shorter than the internodes, glabrous or sparsely papillose-pilose; ligule membranaceous, truncate, about 0.5 mm. long; blades appressed, 3–4.5 cm. long, 2–3 mm. wide, glabrous, with finely scabrous margins; panicles 4–10 cm. long, 1–3 cm. wide, the slender filiform branches rather narrowly ascending; spikelets 1.2 mm. long, glabrous; first glume obtuse, nerveless, less than half as long as the spikelet; second glume very obtuse, 3-nerved, shorter than and exposing the fruit; sterile lemma slightly longer than the fruit, abruptly and minutely pointed; fruit brown, 1 mm. long, shining.

TYPE: in shallow bogs, Savanna I, Tafelberg, Surinam, August 3, 1944, *Maguire 24214*.

Related to *Panicum pyrularium* Hitchc. & Chase which differs in having more conspicuously pyriform spikelets, spreading to reflexed-implicate panicle branches, and broader shorter blades.

Panicum rivale Swallen, sp. nov. Annuum; culmi graciles, erecti, 15 cm. alti, ramosi, glabri; vaginae internodiis plerumque breviores, marginibus sparse pilosae vel papilloso-pilosae; ligula membranacea 1 mm. longa; laminae adscendentes vel patentibus, 2.5–3.3 cm. longae, 4–5 mm. latae, longe pilosae vel fere glabrae; paniculae 3.5–7 cm. longae, pauciflorae, ramis adscendentibus vel patentibus; spiculae 1.2–1.3 mm. longae, subpyriformes, acutae, pedicellis late divergentibus; gluma prima angusta quam spicula duplo brevior; gluma secunda subotusa quam spicula paulo brevior; lemma sterile acutum quam fructu paulo longior; fructus 1 mm. longus, minute stipitatus, minute striatus.

Annual; culms slender, erect, 15 cm. high, simple or usually sparingly branching from the lower nodes, glabrous; sheaths usually shorter than the internodes, sparsely pilose or papillose-pilose toward the summit and on the margins, sometimes nearly glabrous, without a collar, the nerves extending into the blade; ligule membranaceous, about 1 mm. long; blades ascending or spreading, rounded and somewhat clasping at the base, long pilose on both surfaces or nearly glabrous, 2.5–3.3 cm. long, 4–5 mm. wide, the uppermost and those of the branches sometimes reduced; panicles 3.5–7 cm. long, nearly as wide, the few-flowered branches widely ascending, the branchlets

stiffly divergent; spikelets 1.2–1.3 mm. long, elliptic, somewhat pyriform, abruptly acute, on long, filiform, usually widely divergent pedicels; first glume narrow, obtuse, about half as long as the spikelet; second glume obtusish, a little shorter than the fruit; sterile lemma acute, pointed beyond the fruit; fruit 1 mm. long, very minutely stipitate, white, very minutely striate.

TYPE: on banks of lower Augustus Creek, 200 m. above falls, 525 m. altitude, Tafelberg, Surinam, September 13, 1944, *Maguire 24732*.

Panicum rivale is related to the preceding species, differing chiefly in the shorter and broader panicles with more spreading branches and the shorter, broader, and usually spreading blades.

PANICUM ALBOCILIATUM Swallen. *P. pycnoclados* Tutin. BRITISH GUIANA: locally frequent, decumbent, spreading, finally freely branching, the branches short and crowded, Kaieteur Savanna, *23446*. This species was described from Mount Auyantepui, Venezuela. The type specimen is a late branching phase, while *Maguire & Fanshawe* is the early unbranched phase. The type of *P. pycnoclados* is also the branching phase, but the branches are not so numerous nor so crowded. The technical characters of the types are identical.

PANICUM RUDGEI Roem. & Schult. SURINAM: locally abundant, matted, prostrate or scandent, dominant in clearings, swampy bush near Kwatta hede, Saramacca River, *23912*. Venezuela to Bolivia and northern Brazil.

PANICUM MERETENSII Roth. SURINAM: frequent, conspicuous, large panicles with long verticillate branches, marshes, east of Agricultural Experiment Station, Paramaribo, *22711*. Cuba and Trinidad; Mexico to Paraguay.

PANICUM ZIZANIOIDES H.B.K. SURINAM: frequent, marshes, east of Agricultural Experiment Station, Paramaribo, *22712*. Mexico and the West Indies to Paraguay.

ICHNANTHUS AXILLARIS (Nees) Hitchc. & Chase. BRITISH GUIANA: frequent, decumbent-spreading, rooting at the nodes, with small dense short exserted panicles, along trails and in clearings, Kamuni Creek, Groete Creek, Essequibo River, *22843*. SURINAM: frequent in dense shade, low bush bordered by *Montrichardia arborescens* and sparse *Drepanocarpus lunatus*, vicinity of Tawa Creek, Saramacca River, *23742*. Guatemala and the West Indies to Ecuador and Brazil.

ICHNANTHUS PANICOIDES Beauv. BRITISH GUIANA: frequent, broad-leaved woodland grass, with rather dense panicles of large purplish spikelets, in windfall opening in dense second growth, heavy mora forest, Kamuni Creek, Groete Creek, Essequibo River. *22861*. Venezuela, Colombia, Peru, and British Guiana.

ICHNANTHUS RIEDELII (Trin.) Doell. BRITISH GUIANA: occasional, ascending, decumbent-spreading at base, secondary forest, trail from Tukeit to Kaieteur, *23517*. British Guiana, Cayenne, and northern Brazil.

HOMOLEPIS ISOCALYCIA (Meyer) Chase. BRITISH GUIANA: locally frequent, widely decumbent-spreading, rooting at the nodes, stoloniferous, in sand, Kaieteur Savanna, *23287*. Venezuela, Colombia, British Guiana, and Brazil (south to Bahia).

OPLISMENUS HIRTELLUS (L.) Beauv. BRITISH GUIANA: secondary forest on lateritic gravelly soil, Mabaruma, Aruka River, *F2432*. SURINAM: locally

frequent, wet rocks, shaded places at base of cliffs, Augustus Falls, Tafelberg, *24765*. Mexico and the West Indies to Argentina.

LASIACIS LIGULATA Hitchc. & Chase. BRITISH GUIANA: open second-growth forest, Hosorore Hill, Aruka River, *F2391*. SURINAM: frequent, scandent-climbing, opening in high forest, base of north escarpment, Tafelberg, *24315;* Charlesburg Rift, 3 km. north of Paramaribo, *22746;* trail to Coppenam River, rear of Pakka Pakka, *23965*. West Indies; Colombia to Bolivia and Brazil.

SETARIA GENICULATA (Lam.) Beauv. SURINAM: weed, waste places, Kwakoegron, Saramacca River, *25005*. Common in warmer regions throughout the world.

CENCHRUS ECHINATUS L. SURINAM: frequent, along Paramaribo-Carl Francois Road, *23586*. Common weed in warmer regions around the world.

CRYPTOCHLOA CONCINNA (Hook. f.) Swallen. SURINAM: frequent, forest floor, high mixed forest, lower slopes of North Ridge, Table Mountain, *24808*. Nicaragua, Costa Rica, Colombia, and Surinam.

Raddiella Swallen, gen. nov. Monoeca; spiculae masculae et femineae in paniculis separatis dispositae, paniculis masculis terminalibus femineis axillaribus, spicularum pedicellis teretibus; spicula mascula: glumae obsoletae; lemma et palea aequalia, hyalina; lemma 3-nerve, acutum vel subacuminatum; stamina 3; spicula feminea: glumae aequales, acutae, 3-nervae, nervis lateralibus obscuris; fructus ovatus, acutus, induratus; paleae margines plani; annua vel perennis, culmis gracilibus ramosis, laminis planis parvis basi truncatis breve petiolatis.

Staminate and pistillate spikelets on separate inflorescences, the terminal always staminate, the axillary always pistillate; pedicels of spikelets terete, not conspicuously thickened upward, slightly enlarged at the summit forming a minute cup, evident after the disarticulation of the spikelet; staminate spikelet: glumes sometimes evident, usually coalesced with the first joint of the rachilla forming a rounded callus at the base of the spikelet; lemma and palea equal, thin, almost hyaline, the lemma 3-nerved, acute or subacuminate; stamens 3; pistillate spikelet: glumes equal, acute, 3-nerved, the lateral nerves rather faint, adnate at the base to the first joint of the rachilla forming a rounded callus; fruit ovate, acute, indurate, white, smooth, not striate, the margins of the palea flat, not inrolled, entirely enclosing the palea.

Low, branching, often delicate grasses with short deltoid blades.

TYPE SPECIES: *Olyra nana* Doell.

Raddiella nana (Doell) Swallen, comb. nov. *Olyra nana* Doell. BRITISH GUIANA: slender, wiry, tufted grass to 15 cm. high, locally common in sedge bog, Kaieteur Savanna, *23109*. SURINAM: infrequent, wet places, border of low forest, Savanna I, Tafelberg, *24388*. Trinidad, Venezuela, British Guiana, Surinam, and Brazil.

Raddiella Malmeana (Ekman) Swallen, comb. nov. *Olyra Malmeana* Ekman. BRITISH GUIANA: locally common, delicate, pale green, on moist rocks in mixed forest, high level plateau, trail from Tukeit to Kaieteur Plateau, Potaro River Gorge, *23087*. SURINAM: abundant, under drips, base of north escarpment, Tafelberg, *24327*. British Guiana and Brazil.

Raddiella truncata Swallen, sp. nov. Perennis; culmi 15–20 cm. alti, adscendentes, glabri; vaginae internodiis longiores vel frequentes duplo

breviores, glabrae, truncatae; ligula brevissima; laminae 1.5–2.5 cm. longae, 7–10 mm. latae, minute apiculatae, marginibus scabrae; spiculae masculae non visae; spiculae femineae 2.7 mm. longae, ellipticae, subacutae, dense pubescentes.

Perennial; culms in small tufts, ascending or spreading, 15–20 cm. high, glabrous; sheaths overlapping or frequently half as long as the internodes, glabrous, the summit truncate; ligule reduced to a short minutely ciliate rim; blades subsessile, roughly triangular, 1.5–2.5 cm. long, mostly 7–10 mm. wide at the base, obtuse, with a minute point at the tip, glabrous, the margins scabrous; panicles terminal and axillary from the upper sheaths, the terminal apparently staminate, the axillary pistillate, the terminal about 2 cm. long, scarcely exserted from the sheath, the short branches ascending, the axillary pistillate panicles few-flowered, partly included in the sheath; staminate spikelets unknown; pistillate spikelets 2.7 mm. long, elliptic, bluntly pointed, rather densely pubescent.

TYPE: in secondary forest, on white sand, Waratuk Falls, Potaro River Gorge, April 27, 1944, *Maguire & Fanshawe 23035.*

OLYRA LATERALIS (Presl.) Chase. SURINAM: infrequent, climbing on dripping cliffs, west of Grace Falls, Arrowhead Basin, Tafelberg, *24501.* Costa Rica: Colombia to Surinam and Bolivia.

OLYRA LATIFOLIA L. SURINAM: frequent, climbing in primary jungle, 3 km. north of Paramaribo, *22795.* Common, Mexico and the West Indies to Bolivia and Argentina; Africa.

OLYRA CORDIFOLIA H.B.K. BRITISH GUIANA: Barbara Creek, Lower Essequibo River, *F939.* SURINAM: frequent, primary jungle near village, Posoegronoe, Saramacca River, *24032a.* Venezuela to Peru and northern Brazil.

OLYRA OBLIQUIFOLIA Steud. SURINAM: frequent, 1.5 m. high, forming loose clumps, high bush, 0.5 km. south of East Ridge, Tafelberg, *24595;* near village, Posoegronoe, Saramacca River, *24032.* Surinam and northern Brazil.

OLYRA LONGIFOLIA H.B.K. *O. surinamensis* Hochst. BRITISH GUIANA: lax straggling grass in small clumps, 4–5 feet long, creek fringe, Bunsika Creek, Aruwau Creek, Aruka River, *F2445.* Unlike other species of *Olyra* the staminate spikelets are on one of two branches of the inflorescence and the pistillate on the other. Venezuela to Peru and northern Brazil.

OLYRA MICRANTHA H.B.K. SURINAM: frequent, tall, coarse, broad-leaved grass, with dense panicles of small spikelets, damp places, base of south cliffs, high forest, Arrowhead Basin, Tafelberg, *24456;* infrequent, deep shade of heavy bush, rocky slope, river banks below rapids, Jacob kondre, Saramacca River, *23826;* frequent, secondary bush, Zanderij II, *23707.* Venezuela to British Guiana and Paraguay. These are apparently the first collections of this species from Surinam. Colombia to Surinam, Bolivia, and Argentina.

PARIANA LONGIFLORA Tutin. BRITISH GUIANA: frequent, widely creeping grass with leafy sterile culms and leafless fertile culms, forest floor, mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22829.* British Guiana (Mazaruni Station, type [*Tutin 39*]) and northern Brazil (Mosqueira, Pará [*Swallen 4868*]). These three are the only specimens known of this species.

PARIANA ZINGIBERINA Doell. BRITISH GUIANA: in large clumps in riparian forest, the leafy sterile culms tall, the leafless sterile culms short, hidden in the foliage, Takutu Creek to Puruni River, Mazaruni River, *F2150.* Venezuela and British Guiana.

PHARUS LATIFOLIUS L. SURINAM: infrequent, erect, broad-leaved woodland grass, shady bush, trail to rear of village, Jacob kondre, *32892*. Widely distributed in moist forests, Central America, the West Indies, and northern South America.

PHARUS PARVIFOLIA Nash. SURINAM: locally frequent, creeping, wet rocks, shaded places at base of cliffs, Augusta Falls, Tafelberg, *24766*. Mexico and the West Indies to Brazil.

ANDROPOGON BICORNIS L. BRITISH GUIANA: occasional, coarse, densely tufted grass with conspicuous white plume-like inflorescence, between bush islands on Kaieteur Savanna, *23404;* dry rocks, trail from Kaieteur to Tukeit, *23473*. Southern Mexico and the West Indies to Bolivia and Argentina.

ANDROPOGON ANGUSTATUS (Presl.) Steud. SURINAM: frequent on rocks, Gran dam Saramacca River, *21935*. Cuba; Mexico to Brazil.

CYPERACEAE[20]

The striking characteristic of this interesting collection of sedges is the broad iris-like nature of the leaves, to be observed especially in such genera as *Mapania, Diplasia, Becquerelia,* and even in *Rynchospora.* Many are inhabitants of swamps, and that environment may perhaps account for the convergent evolution of equitant leaves in several genera. At any rate, the mountainous areas of British Guiana and Surinam are among the world's most interesting places for Cyperaceae, and the localized species to be found there present difficult problems in identification. The chief relationship of the restricted species seems to be with the uplands of eastern Brazil; some genera such as *Mapania, Hypolytrum,* and *Trilepis,* are primarily African or Asian. Our knowledge of the cyperaceous flora of British Guiana is based on fragmentary reports by a number of botanists. For Surinam, there is fortunately a comprehensive account of Uittien in Pulle's *Flora of Surinam,* vol. 1, p. 72–149 (1934), and I have referred to his treatment of species by citing the page number in parentheses. Only a relatively small area of Surinam and British Guiana has been explored, and the number of Cyperaceae will undoubtedly be much extended through further exploration.

CYPERUS DIFFUSUS Vahl (84). SURINAM: perennial with long culms, numerous long leaf-like bracts surrounding the sparsely branched radiate inflorescence, frequent, in shaded bush trails above Kwatta hede, Saramacca River, *23950*. Mexico to Argentina and in the Old World tropics.

CYPERUS DIFFUSUS var. TOLUCENSIS (H.B.K.) Kükenth. SURINAM: with broader leaves and more branched inflorescence, frequent, in clearings, Charlesburg Rift, 3 km. north of Paramaribo, *22740*. Mexico to Bolivia.

CYPERUS FLAVUS (Vahl) Nees. *C. cayennensis* (Lam.) Britton (93). BRITISH GUIANA: perennial with short thickened rhizomes and dense cylindric sessile spikes, occasional along Potaro River, *22999*. An abundant plant from southern United States to Argentina.

CYPERUS GIGANTEUS Vahl (90). BRITISH GUIANA: aquatic with leaf-

[20] By Henry K. Svenson.

less culms to 2.5 m. high, in river tidal flats, Mazaruni Forest Station, *23567*. Mexico to Argentina.

CYPERUS LUZULAE Retz. (85). BRITISH GUIANA: perennial with short woody rhizomes, the small flattened spikelets glomerulate in a compound inflorescence, frequent in wet forest openings, Kamuni Creek, Essequibo River, *22896*. SURINAM: clearings, Charlesburg Rift, 3 km. north of Paramaribo, *22730*. Abundant from West Indies to Paraguay.

CYPERUS POLYSTACHYUS Rottb. (78). SURINAM: annual with short leaves, pale green to yellow spikelets in compound spikes, frequent in sand in clearings, Charlesburg Rift, *22736*, *22737*. Abundant in all tropical and warm temperate countries throughout the world.

CYPERUS SIMPLEX HBK. (82). SURINAM: low perennial with rays much longer than the culms, frequent in open areas along trail, Jacob kondre, Saramacca River, *23753*. Southern Mexico to Brazil and Bolivia.

CYPERUS SUBUMBELLATUS Kükenth. *Mariscus umbellatus* Vahl (92). SURINAM: perennial with densely cylindric spikes on long rays, frequent in sand, clearings, Charlesburg Rift, *22731*. Tropical Africa and Madagascar; occasionally introduced in the West Indies. It was collected by Lanjouw at Paramaribo.

CYPERUS SURINAMENSIS Rottb. (84). SURINAM: perennial with slender rough culms, compound umbels with small flattened spikelets, frequent in sand, clearings, Charlesburg Rift, *22735*. Abundantly distributed from Florida to Argentina.

KYLLINGA PUNGENS Link (76). SURINAM: frequent perennial with coarse creeping rootstocks, rigid culms and bracts, in sand north of Paramaribo, *22751*. Tropical America and West Africa.

HEMICARPHA MICRANTHA (Vahl) Britton (126). SURINAM: frequent in sand banks along railroad bed, Kwakoegron, *23775*; weed in sand about Kwatta hede, Saramacca River, *23951*. The plants are robust (15 cm. high) but otherwise the same as the type of *Scirpus micranthus*, which I examined in Vahl's herbarium in 1937. The type is a single small plant 6 cm. high, with spikelets 3–4 mm. long, the somewhat mucronate scales rather closely appressed to the achene, with only the tips divergent. The achenes average 0.67×0.3 mm. The collection (from Jussieu) came from South America, possibly from the coast of Peru, where I collected similar material in 1941, and where Jussieu was known to have collected extensively. No. 23951 shows occasional acicular remains of reduced scales which can be readily made out with a binocular. These are most frequent above the middle of the spikelet. Widely distributed in North and South America.

SCIRPUS CUBENSIS Poeppig & Kunth. BRITISH GUIANA: semi-aquatic sedge forming pure clumps 10–20 feet in diameter by river bank in places where there are habitations—spreading by runners, flowers brownish-green, Mt. Everard, Barima River, British Guiana, *F2351*. Known from Central America and the West Indies to Argentina; tropical Africa.

ELEOCHARIS GENICULATA (L.) R. & S. (113). BRITISH GUIANA: the coarse culms have prominent cross-bars, and the many-flowered inflorescence is brownish, river tidal flats, Mazaruni Forest Station, *23574*. Of wide range in tropical America.

ELEOCHARIS INTERSTINCTA (Vahl) R. & S. (110). SURINAM: Kwakoegron, *25010*; wet sand, Zanderij II, *25032*. Resembles *E. geniculata* but has coriaceous yellow appressed scales. Distribution as in *E. geniculata*.

ELEOCHARIS cf. SUBFOLIATA Clarke. SURINAM: small aquatic in flowing water, lower Augustus Creek, Tafelberg, *24729;* Geijskes Creek, Tafelberg, *24834;* wet sand, Grasi Falls, Saramacca River, *24944.* No achenes are present; *E. subfoliata* is known only from British Guiana and adjacent Brazil.

FUIRENA UMBELLATA Rottb. (124). SURINAM: a tall plant with 4-angled stem, in wet sand, Zanderij II, *25031.* Widely distributed in the American tropics.

BULBOSTYLIS JUNCIFORMIS (HBK) Lindman (118). BRITISH GUIANA: Ituni Road, Demerara River, *F2504.* SURINAM: a nearly glabrous wiry perennial in savannas, Zanderij I, *23727, 24977.* Widely distributed from Mexico and the West Indies to eastern Brazil.

. BULBOSTYLIS LANATA (HBK) Clarke (115). SURINAM: perennial with an enormous woody base, resembling *B. paradoxa* but with the rhizome apex woolly and scales obtuse, savannas in vicinity of Arawak village, *24968.* Known also from Venezuela and British Guiana.

FIMBRISTYLIS ANNUA var. DIPHYLLA (Retz) Kükenth. (122). BRITISH GUIANA: Garraway Stream, Potaro River, *22987;* tufted rock plants in white sand, Kaieteur Savanna, *23118.* Widely distributed as a weedy plant in all tropical regions.

FIMBRISTYLIS ASPERA (Schrader) Böck. BRITISH GUIANA: tufted sedge to 70 cm. high, long coriaceous equitant leaves 6–8 mm wide, and shiny chocolate-brown leaf bases, on river bank, Kaieteur Savanna, *23222.* This is a rare plant known previously only from eastern Brazil.

FIMBRISTYLIS COMPLANATA (Retz.) Link (123). SURINAM: annual with soft compressed culms, in ditches of savanna, vicinity Sectie O, km. 68, *25028.* Widely distributed in the tropics.

FIMBRISTYLIS MILIACEA (L.) Vahl (123). BRITISH GUIANA: opening along Kamuni Creek, Groete Creek, Essequibo River, *22895.* SURINAM: a common tropical weed with small spherical spikelets, in wet places, Experiment Station, Paramaribo, *22709.*

RYNCHOSPORA ARENICOLA Uitt. (101). BRITISH GUIANA: cespitose perennial with narrow coriaceous leaves, the long culms each with a single globose head, common in Kaieteur Savannas, *23115.* SURINAM: infrequent, in sand, savanna, Zanderij I, *23729a. R. arenicola* has previously been considered endemic to Surinam. It is distinguished by Uittien from *R. pilosa* Boeckl., of eastern and southern Brazil, only by the sparse pubescence and large pale spikelets.

RYNCHOSPORA BARBATA (Vahl) Kunth. (100). BRITISH GUIANA: tufted glabrous perennial, each culm with a single globular head, frequent rock plant, in white sands, Kaieteur Savannas, *23098.* SURINM: common, Savanna II, Tafelberg, *24224;* savanna, Zanderij II, *23669.* One of the commonest tropical American species of *Rynchospora*, extending from Panama and the West Indies to Brazil.

RYNCHOSPORA CEPHALOTES Vahl (106). BRITISH GUIANA: occasional to frequent tufted perennial, the inflorescence varying from capitate to elongate-paniculate, in forest or rocky openings, Amatuk Portage, *23025;* Kaieteur Savannas, *23324.* SURINAM: Arrowhead Basin, Tafelberg, *24493;* 1 km. southeast of Savanna VIII, Tafelberg, *24550;* Tawa Creek, Saramacca River, *23746;* banks Geijskes Creek, high mixed wallaba forest, km. 17, Black Water Camp (5), *24847.* The most common forest *Rynchospora* of tropical America.

RYNCHOSPORA COMATA Schultes (107). SURINAM: infrequent, in montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24138*. This plant (sect. *Psilocarya*) has the general appearance of *R. cephalotes* except that it has a loose corymb of large individual spikelets.

RYNCHOSPORA CURVULA Griseb. BRITISH GUIANA: annual with spreading filiform culms in damp sand, Kaieteur Savannas, *23312*. A little plant with the aspect of *Carex pauciflora*, known only from Surinam, British Guiana, and Trinidad. (cf. Uittien, *Additions to Pulle's Flora of Surinam* 1, p. 30. 1935 [Rec. Trav. Bot. Néerl. 32].)

RYNCHOSPORA CYPEROIDES (Sw.) Mart. (102). SURINAM: frequent annual with a spreading inflorescence of long-rayed globular heads, in coastal jungle along Saramacca River, 79 km. from Paramaribo, *23600a;* in white sand, Zanderij II, *25029, 23648*. Widespread in tropical Africa and tropical America.

RYNCHOSPORA GRAMINEA Uitt. (p. 105) and Rec. Trav. Bot. Néerl. **32**: 219 (1935). *R. longispicata* Clarke; Urban. Symb. Ant. **2**: 122 (1900), not Böck. (1873). *R. filiformis* var. *latifolia* Uittien. The linear spikelets (ca. 7 mm. long) are in a diffuse corymb. Uittien knew this species as endemic to Surinam from collections by Pulle and Essed in the savanna of Zanderij, but suspected it to be of wider distribution. Maguire finds it frequent in the grass savanna, Zanderij II, *23675*, and also has it from dry sands in the Kaieteur Savannas of British Guiana, *23308*.

RYNCHOSPORA TENELLA (Nees) Böckl. (108). SURINAM: a dwarf annual with the aspect of slender *Fimbristylis autumnalis*, infrequent in shallow sand, Savanna II, Tafelberg, *24251*. Described from banks of the Apapuris River in Brazil (close to the southeastern boundary of Colombia); otherwise known only from Surinam.

RYNCHOSPORA TENUIS Link (104). BRITISH GUIANA: procumbent tufted annual with filiform leaves and pale brown corymbose inflorescence, locally frequent in dry sand, Kaieteur Savannas, *23163, 23307*. A widespread species from Mexico and the West Indies to Argentina. In the Surinam collections it is represented by var. *maritima* Boeckl., with larger congested spikelets and apparently perennial culm bases with more extensive fibrous roots; wet sands, Savanna II, Tafelberg, *24251a* (diseased, with no achenes), and Zanderij II, *25030*. Some plants of the latter collection are identical with *la Cruz 4350*, from the Upper Mazaruni River, named by N. E. Brown as *R. riparia* Böck. (based on a Pohl collection from Goyaz, Brazil). Achenes of *25030* are typically those of *Rynchospora tenuis*. The variety is cited by Böckeler from Brazil, Mexico, and Surinam, and the name comes from "*Schoenus maritimus* Salzm. Lindl. herb." Since *Haloschoenus capillaris* var. *congestus* Nees is given as a synonym by Böckeler, a change in the varietal name will probably be necessary when taxonomic difficulties have been cleared.

DICHROMENA CILIATA Vahl (97). SURINAM: perennial with whitened bracts surrounding a terminal cluster of spikelets, frequent in marshes and borders of swamps, Charlesburg Rift, north of Paramaribo, *22721*. Widely distributed in tropical America.

DICHROMENA PUBERA Vahl (96). BRITISH GUIANA: Garraway Stream, Potaro River, *22998*. SURINAM: grass savanna, Zanderij II, *23664*. Possibly annual, with shorter leaves than in *D. ciliata*, from which it differs chiefly

in the pubescent spikelets and more sharply ridged achenes. Widely distributed in tropical South America, but less frequent than *D. ciliata.*

DICHROMENA REPENS Vahl (96). SURINAM: a slender annual (?) with decumbent rooting stems, and scarcely whitened bracts, Gran dam, Saramacca River, *24924*. Known only from the Guianas.

DIPLASIA KARATAEFOLIA L. C. Rich. (127). A gigantic sedge with broad coriaceous leaves and cylindric spikes on elongate rays. The achene is about 6 mm. long with the form of an oat grain. BRITISH GUIANA: frequent, Kamuni Creek, Groete Creek, Essequibo River, *22850*. SURINAM: secondary bush, Zanderij II, *23647*, *23708*.

MAPANIA SYLVATICA Aubl. (128). Herb with leafless culms, each surmounted by three broad-leaved bracts enclosing the inflorescence. BRITISH GUIANA: locally frequent on forest floor, Kamuni Creek, Groete Creek, Essequibo River, *22831*. SURINAM: frequent in low forest, line beyond Pakira Camp (4), Coppenam River Headwaters, *24167*. Compression of the spikelets in *Mapania* and associated genera has made the interpretation of the actual structure very difficult. It seems clear to me that a single terminal flower is represented, and not a group of flowers, and that the scales are alternate in arrangement with the three stamens. The other, and I believe incorrect, interpretation is that each stamen and associated bract is a distinct flower. Two of the outer series of scales are greatly strongly compressed laterally and ciliated much as in the genus *Xyris*. So far as attachment of filaments is concerned, the flower of typical *Mapania* would appear to be a perfectly normal representative of the Cyperaceae. *M. sylvatica* is known from Costa Rica and Panama to Venezuela and the Guianas. This illustration (fig. 3B), based on *Maguire 24167*, shows (*a*) a single flower much magnified; (*b*) a diagrammatic section of a flower, showing its compressed nature and relation of the scales and stamens; (*c*) a mature achene and three-parted style.

MAPANIA aff. PYCNOCEPHALA Benth. (Fig. 4.) SURINAM: broad-leaved plants about 1 m. high, with firm trigonous culms, and with glistening castaneous leaf-bases, locally common, in swamps, at top of North Ridge, Tafelberg, *24242*. *M. pycnocephala* was described from Gorgona Island off the west coast of Colombia, and has been cited by Standley from Costa Rica. The illustration by Clarke (Ill. Cyp. *pl. 113*) shows a plant with much less compact inflorescence and with only two stamens. The almost tubular inrollment of scales about the stamens makes it difficult to determine whether these scales are actually alternate with the stamens or opposite them. If they are alternate, the flower is a terminal one, and no different in its structure than that of *Mapania sylvatica* (the type species of the genus) except that two of the outer scales are lacking. Our illustration, based on *Maguire 24242,* shows (*a*) a fragment of the inflorescence with a number of spikelets, (*b*) an achene, (*c*) a single flower, (*d*) a diagrammatic cross-section of a flower, showing the large enveloping outer bract, the axial bract adjacent to the style, and the three bracts each enclosing a staminal filament.

No. 24242 probably represents *M. surinamensis* Uittien, in Pulle's Fl. Surinam **1**: 128 (1934; *M. montana* Uittien, not Ridley), which is known only from Mt. Hendrik Top and the Wilhelmina Mountains, Surinam, with which it agrees, at least partly, in flower structure.

MAPANIA MACROPHYLLA (Bock.) H. Pfeiff. *M. Schomburgkii* Clarke

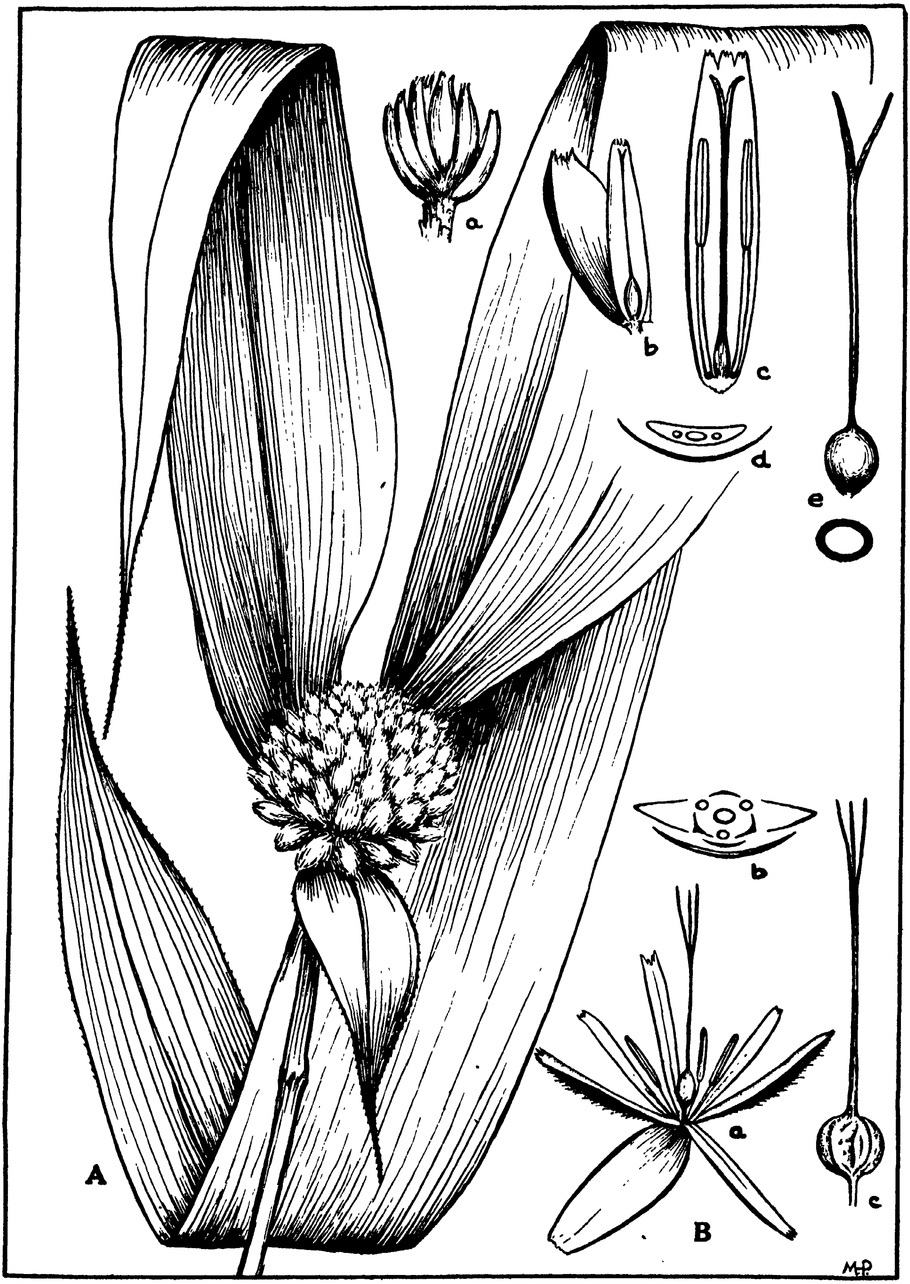

FIG. 3. A. *Mapania macrophylla* (Böck.) H. Pfeiff. *Maguire & Fanshawe 23017*, in fruit; *23545*, in flower. *a*, a fragment of one of the "spikelets." *b*, a flower with accompanying scale. *c*, a flower as seen through the transparent "corolla." *d*, a cross-section of the flower with adjacent bract. *e*, fruit (with style) and its cross-section. B. *Mapania sylvatica* Aubl. *Maguire 24167*. *a*, a single flower much amplified. *b*, a diagrammatic section of a flower, showing the compressed nature and relation of scale and stamen. *c*, a mature achene and 3-parted style.

(128). (Fig. 3A.) BRITISH GUIANA: Perennial tufted herb to 2 m. high, with broad basal leaves, naked culms, and 3 bracts (the largest as much as 8 cm. broad) ending in acuminate sharp-toothed apices; occasional in marshy areas in white sand, in secondary scrub forest, Amatuk Portage, Potaro River, *23017* (in fruit); *23545* (in flower); in wet dicymbe forest, Warratuk Portage, Potaro River, *23539* (in fruit).

All these appear to be the same and to coincide with Schomburgk's collection, though the spikelets rapidly disintegrate and their structure is not discernible in the fruiting stage. This certainly is one of the most remarkable and primitive members of the Cyperaceae—it cannot belong to any other family. The strongly flattened delicate and transparent lacerate-tipped "corolla" is 9.5 mm. long, the stamens 3.5 mm. long. Sandwith, Kew Bull. **1933**: 496, has described *M. insignis* from the Potaro River (based on *Jenman 7478*). The description of this species agrees in general with Maguire's collections, but is described as having 3 stamens, each 2.2–3 mm. long, and four scales, 9–11 mm. long, the two lateral flattened and keeled, the keel entirely smooth. It is quite possible that the membranous "corolla" splits up later to form structures as described by Sandwith, but I have not been able to see such a transformation. Uittien says of *M. macrophylla* (p. 129), "Glumes 1 cm. long. Flowers with only one large petal. Stamen 1." Clarke's figure (Ill. Cyp. *pl. 113*) was drawn from a Schomburgk specimen, but shows only the fruit. Pfeiffer, Rep. Spec. Nov. **28**: 22 (1930), notes that the species is imperfectly known with "squamellae 6 (?), albidae, cum maxima parte glumae aequilongae." *M. macroprylla* is known from San Domingo and British Guiana.

Our illustration shows (*a*) a fragment of one of the "spikelets"; (*b*) a flower with accompanying scale; (*c*) a flower as seen through the transparent "corolla"; (*d*) a cross-section of the flower with adjacent bract; (*e*) fruit (with style) and its cross-section.

HYPOLYTRUM PULCHRUM (Rudge) Pfeiffer, Bot. Arch. **12**: 450. 1925. *H. pungens* (Vahl) Kunth. *H. rigens* Nees (p. 130). SURINAM: perennial with elongate scale rhizomes and narrow inrolled triquetrous leaves not exceeding 4 mm. in width, the head composed of 6–15 oblong spikelets; in savannas, Arawak village Mata, *24974*; vicinity Sectie O, km. 68, *25012*; in grass savanna, Zanderij II, *23649*. Specimens agree with Schweinitz's collection from Surinam, with *Hitchcock 10949* from Georgetown, and with *Tate 1366* from Auyan-tepui, Venezuela. Known from the Guianas, Venezuela, and from Minas Geraes, Brazil.

HYPOLYTRUM sp. SURINAM: perennial, apparently with a vertical rhizome; culms 1.5–4.5 dm. high, mostly leafless, covered at the base by the dilated red leaf-sheaths; leaves acuminate, exceeding the culms, 10–25 mm. broad, the base narrowed into a petiole; locally common in swamps, Savanna I, Tafelberg, *24364*; frequent on stony banks of lower Augustus Creek, Tafelberg, *24730*.

No. *24364* has a large pseudo-corymbose long-bracteate inflorescence reminiscent of *Eryngium*. The 8 main heads (1–1.5 cm. diam.) are on rays up to 4 cm. long, each with 2 or 3 satellite heads on short reflexed rays, and are composed of very numerous, small, 1-flowered flattened spikelets, from which the prominent whitened tips of the achenes protrude. In no. *24730*, which has slender culms not exceeding 2 dm., the inflorescence is reduced

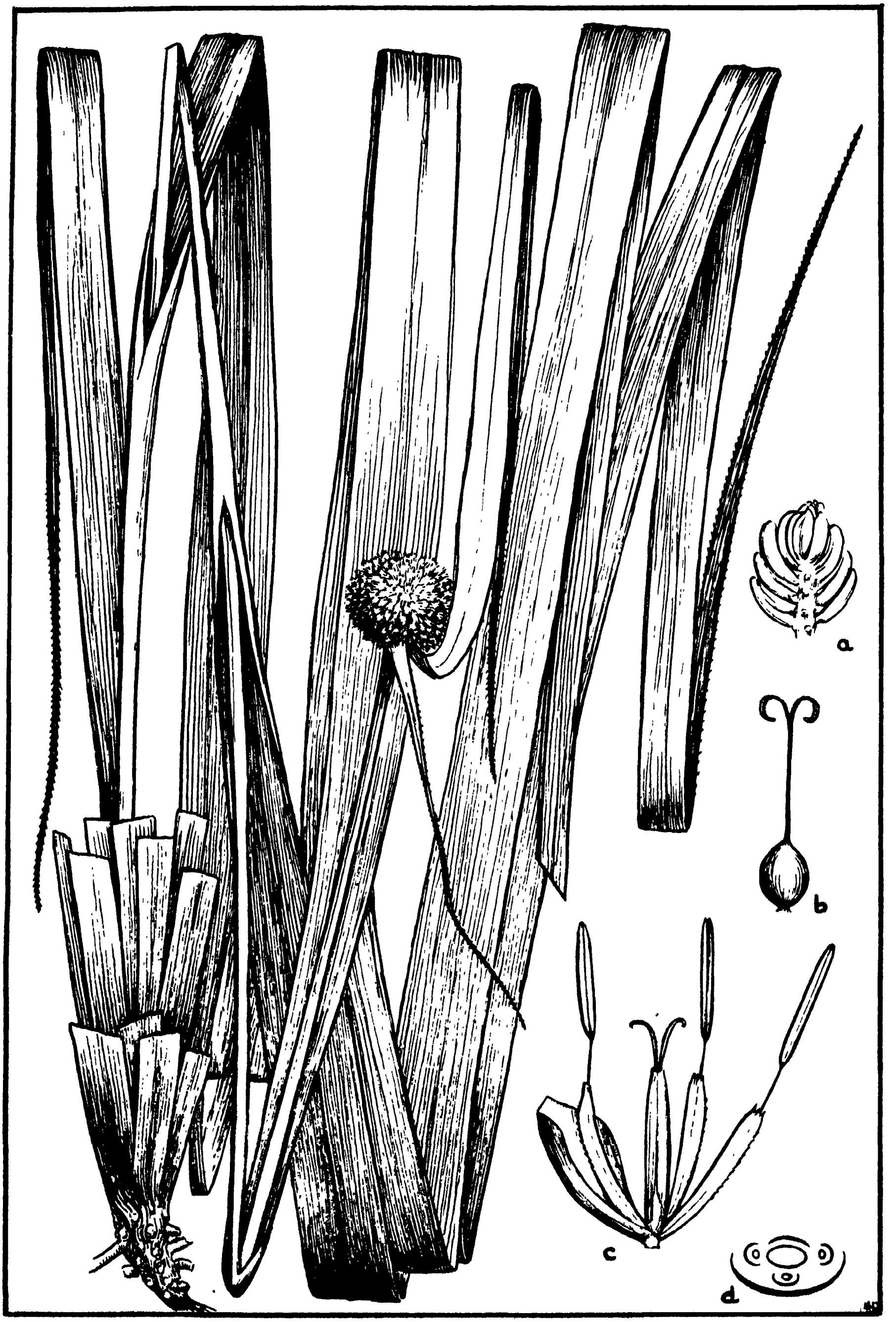

FIG. 4. *Mapania* aff. *pycnocephala* Benth. *Maguire 24242*. *a*, a fragment of an inflorescence with a number of spikelets. *b*, an achene. *c*, a single flower. *d*, a diagrammatic cross-section of a flower.

to a nearly capitate form. Each spikelet consists of a thin bract 2.5 mm. long, and 3 similar brown scales each 3 mm. in length. These 3 scales vary greatly in width, and 2 of them are sometimes united to form a sort of tube; none of them show any ciliation or thickening of the keel. The biconvex achenes, 3.5 mm. long and 1–1.5 mm. wide, have ⅔ of their length occupied by a soft, pale gray, spongy beak, streaked with brown. The thick-walled, orbicular achene-body is smooth and pale yellow. There are 2 stamens and the style is 2-parted to the base. The long beak of the achene is somewhat similar to that of *H. strictum* Kunth, as illustrated by Clarke (Ill. Cyp. *pl. 103, fig. 18*); otherwise the plants have little in common. I have not seen any specimens similar to Maguire's and perhaps they represent a new species; but the species already described within this genus are too poorly known for adequate reference.

SCLERIA ARUNDINACEA Kunth, Enum. **2**: 347. 1837. BRITISH GUIANA: sedge with winged stems to 6 feet tall, broad leaves (4 cm. wide) and depressed-globose, white-to-purplish achenes, on lateritic soil, Mabaruma, Aruka River, *Fanshawe 2356*. Abundant in forest clearings from Central America and the West Indies to Argentina. This species is united with *S. latifolia* Sw. by Uittien (p. 143); Core is also of the opinion that the two species are perhaps not distinct.

SCLERIA MACROGYNE Clarke. Perennial, in clumps to 1 m. tall, the sheath-ligules with a prominent scarious margin. BRITISH GUIANA: Kangaruma, Potaro River, *23002a*; Kaieteur Savanna, *23104*. SURINAM: in thickets, among shrubs, or along borders of Savanna I, Tafelberg, *24398*.

Uittien and Core differ on disposal of names in this difficult *Hymenolytrum* group. Clarke thought that British Guiana material (*S. macrogyne*) differed from the Brazilian *Hymenolytrum Martii* Nees in having a sharply-angled achene, but Uittien has described the achene of *S. Martii* also as trigonous and resembling a grain of buckwheat. The real question is whether Nees' illustration of *H. Martii*, in which the achene has rather blunt angles, really represents mature fruit—it probably does not. Core thinks that *Scleria violacea* Pilger—a photograph of which to me appears identical with *24398*—should probably be called *Scleria Martii* (Nees) Steudel; and *23002a* certainly belongs with Uittien's description of *S. Martii*. From *23002a*, *24398* differs in its smoother culms and purple panicle with smaller blunter achenes. By Uittien this latter specimen would probably be treated as *S. pyramidalis* Hochst, and by Core as *S. violacea* Pilger. *23104* is very immature, but the veining of the ligule is exactly that of *24398*. I have followed Core in treating the Guiana material of these widespread plants as *S. macrogyne*.

SCLERIA MICROCOCCA (Liebm.) Steud. *S. Liebmanni* Steud. (135). SURINAM: infrequent annual with verticillate inflorescence, in open places, Savanna II, Tafelberg, *24250a*, *24250* (frequent). Ranges from Mexico and Cuba to southern Brazil.

SCLERIA MITIS Bergius (142). SURINAM: a wide-leaved species with narrow elongate inflorescence and white achenes only 2 mm. wide, common in clearings, Lamke kondre, Saramacca River, *23903*. Known from the West Indies and Panama to southern Brazil.

SCLERIA PTEROTA Presl (140). SURINAM: 3 km. north of Paramaribo, *22747*; frequent in secondary jungle, along stream, Jacob kondre, *23839* (var. *melaleuca* [Schlecht.] Uitt.). Perhaps the most abundant species of

Scleria in the American tropics, forming erect clumps a foot or two in height. The achenes vary from white to deep purple.

SCLERIA SECANS (L.) Urb. (139). SURINAM: frequent, the slender saw-toothed stems climb over the underbrush, primary jungle, 3 km. north of Paramaribo, *22796*. Wide tropical distribution.

BECQUERELIA CYMOSA Brongn. (144). A large broad-leaved perennial resembling *Scleria*, but with the achenes surrounded by bracts much in the manner of *Diplacrum*. SURINAM: in swampy bush above village of Jacob kondre, Saramacca River, *23839a*. Widely distributed from the West Indies to the Guianas and Brazil.

BISBOECKELERA LONGIFOLIA (Rudge) Standley (145). BRITISH GUIANA: a broad-leaved low perennial, with small (5 mm. long) cream-colored flower heads, locally frequent, in dicymbe forest, Tukeit, Potaro River, *23538*. *Bisboeckelera* is the old genus *Hoppia*, in which a perigynium analogous (but probably not homologous) to that of *Carex*, surrounds the achene. The genus is exceedingly close to *Calyptrocarya*, which it resembles in general aspect. Uittien says that *B. longifolia* is endemic to Surinam, but it is well known that Rudge's specimens were collected in French Guiana by Joseph Martin, who was a garden director at Cayenne.

CALYPTROCARYA GLOMERULATA Nees. *C. fragifera* Kunth. *C. angustifolia* Nees. (147). A low tufted sedge in damp forests. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River, *22816*, *22848*; Kaieteur Savanna, *23250*. SURINAM: Saramacca trail, Jacob kondre, Saramacca River, *23838*; dakama forest, bottom Arrowhead Basin, Tafelberg, *24617*.

A variable species, represented in these collections by plants with leaves as much as 7 mm. wide (*23250*), and as narrow as 1.5 mm. (*24617*), the latter being representative of *C. angustifolia*. *C. intermedia* Clarke, noted by him as intermediate between *C. fragifera* and *C. Poeppigiana* and based partly on Im Thurn's collections from British Guiana, probably represents the broad-leaved phase of Maguire's collections. Below the achene is a disc, much as in *Scleria*, from the base of which several staminate spikelets radiate. Species of *Calyptrocarya* resemble *Bisboeckelera*, differing only in the non-fused scales which surround the achene. *C. glomerulata* is very common in the American tropics from British Honduras and Guatemala to Brazil.

CALYPTROCARYA POEPPIGIANA Kunth (147). SURINAM: frequent, secondary bush, Zanderij II, *23702*. Differs from *C. glomerulata* in broader leaves which are microscopically grayish pubescent, and in the larger achenes. Known from Peru and Colombia to northern Brazil.

LAGENOCARPUS AMAZONICUS (Clarke) Pfeiffer, Rep. Spec. Nov. **21**: 35. 1925. *Exochogyne amazonica* Clarke, Verh. Bot. Ver. Brand. **47**: 101. 1908. Tutin in Hook. Ic. **33**: *pl. 3273*. 1934. SURINAM: infrequent herb, with a single zigzag inflorescence at the culm apex, in small savanna northwest of Savanna VIII, Tafelberg, *24433*; rare in small rock savanna, low forest, northwest of Savanna VIII, Tafelberg, *24601*. The anthers are strongly fringed at the tip.

These collections were identified as *E. amazonica* by F. J. Hermann, who notes that the type specimen of *E. megalorryncha*, from the Potaro River, British Guiana, is "not nearly so pilose as Tutin described and figured" it (Hook. Ic. **33**: *pl. 3274*). *L. amazonicus* is said by Pfeiffer to be closest to the Brazilian *L. ciliatus* (Böck.) Pfeiffer, but it would seem to be perhaps

a much reduced *L. Kunthii. Exochogyne amazonica* was based on *Ule 6128* from the Marmellos River, a tributary of the Madeira; *E. decandra* Tutin came from Manaos (*Ule 8816*). *Exochogyne* has not been previously known from Surinam. The three described species are exceedingly close to one another, and probably not distinct.

LAGENOCARPUS KUNTHII (Miq.) Uittien. (132). *Cryptangium leptocladum* Böck. SURINAM: a slender species with filiform elongate panicles, south savannas, vicinity Arawak village of Mata, *24967*. Known also from the Amazon region of Brazil.

LAGENOCARPUS TREMULUS Nees (132). A tall (at least 1 m. high) coarse plant with culms as much as 1 cm. thick. BRITISH GUIANA: common, Kaieteur Savannas, *23465*. SURINAM: grass savanna, Zanderij II, *23660;* common, Savanna I, Tafelberg, *24221*.

Lagenocarpus is a difficult genus, mainly because very few collections have ripe fruit. Both *L. guianensis* and *L. tremulus* were based on collections made by Schomburgk in British Guiana, the latter species in a young stage without achenes. Uittien has separated the two on the basis of leaf width (15–35 mm. wide in *L. guianensis;* 6 mm. wide in *L. tremulus*) and on the character of the achenes. In *L. guianensis* the achenes are elongate-tapering, generally olive-gray in color; in *L. tremulus* they are shining brown, elliptic, and only 2 mm. long. The "perianth" of *Lagenocarpus* varies from a minute 3-lobed scale to three bristles which may be half the length of the achene. In the presence of a 3-lobed scale *Lagenocarpus* resembles *Scleria*. Except that the bristles in *Everardia* are finely divided, there semes to be but little difference between *Everardia* and *Lagenocarpus*.

CEPHALOCARPUS aff. RIGIDUS Gilly, Brittonia **3**: 152. 1939. Bull. Torrey Club **69**: 296, *f. 1*. 1942. BRITISH GUIANA: forming tussocks, branched or simple, rare, Kaieteur Savanna, *23453*. The leaves are 4–5 cm. long and 1.75 mm. wide; bracts 8–12 mm. long and conspicuously spreading-pubescent at base. The yellow to dark brown achene-body is 1.3–1.5 mm. long, 0.8–1.0 mm. wide, and the persistent (or tardily deciduous) beak sparsely pubescent, reddish-brown, becoming yellow in age. Hypogynous bristles, rising from a very low disc, are 0.6 mm. long. This collection does not fit well into Gilly's key because of the pubescent bract-sheaths, deciduous achene-beaks, and relatively narrow achenes. It has the general appearance of *C. longebracteatus* Gilly, but the pubescence is much as in the type of *C. rigidus* var. *mucronatus*. *C. rigidus* is known from the high plateaus of Venezuela.

DIDYMIANDRUM STELLATUM (Bock.) Gilly, Bull. Torrey Club **68**: 331, 1941. BRITISH GUIANA: tufted sedge to 2 m. high, leaves whorled, horizontal in three's, flower spikes erect, drooping at tip, Kaieteur Savannas, *23230* (staminate plant only). The species was collected originally by Schomburgk, probably during his visits to Roraima in 1838 and 1842, and was noted by Everard Im Thurm on his Mt. Roraima expedition in 1884. Böckeler called the plant *Cryptangium stellatum* in 1874. *Cryptangium* was placed under *Lagenocarpus* by both C. B. Clarke (1908) and Pfeiffer (1921), but *C. stellatum* was segregated out as a genus by Gilly chiefly on account of the dioecious character and the subverticillate arrangement of the leaves. Endemic to British Guiana.

EVERARDIA MONTANA Ridley. Perennial with a massive vertical rootstock, topped by a crown of narrow coriaceous leaves and several paniculate in-

florescences. SURINAM: frequent in wet places, Savanna IV, Tafelberg, *24382;* infrequent, moist rocky places, base of west escarpment, Tafelberg, *24679.*

Both collections agree well with the original description and plate, though Ridley quite evidently had immature and insufficient material for delineation of the pistillate spikes. Especially in *24382,* the upper portion of the inflorescence is predominantly staminate and does not conform to Gilly's characterization of *Everardia* (Bull. Torrey Club **68**) as having the "upper portion of the inflorescence wholly pistillate or rarely with a few staminate spikelets—accompanying the pistillate." Character of sheaths and disposition of the inflorescence branches coincide with the situation in *Lagenocarpus.*

From *Cephalocarpus* Maguire's collections are not readily separated. The achenes have a shrinking of the neck in age that would place them in *Cephalocarpus.* The hypogynous cup formed by fusion of three small scales in *Cephalocarpus,* as in *Everardia,* can also be readily seen in *Lagenocarpus,* except that the scales are not fringed. *Maguire 23482* has within itself the characteristics of *Everardia, Cephalocarpus,* and *Lagenocarpus.* Perhaps Pfeiffer was correct in placing the small genus *Cephalocarpus* within *Lagenocarpus.*

PALMAE[21]

The large proportion of novelties in this small palm collection well illustrates the need for continued botanical exploration of the hinterlands of the Guianas—Venezuelan, British, Dutch, French, Brazilian.

BACTRIS sp. SURINAM: frequent, stems 3–5 m. high, savanna bush, Savanna VIII, Tafelberg, *24461.* No fruit and therefore cannot be identified. Very close to *B. savannarum* Britt. but probably not the same.

HYOSPATHE sp. SURINAM: frequent, canes 2 m., leaves cut, inflorescence red, mostly hillsides in forest, and borders of swamps, sometimes in swamps, vicinity Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24116;* locally common, leaves cut, swamps, km. 14, line between Kwatta and Pakira Camps (3 and 4), Coppenam River Headwaters, *24155.* No fruit. Perhaps related to *H. elegans* Mart. of Brazil.

GEONOMA ACAULIS (Poit.) Burret. SURINAM: frequent, without cane, stem short, leaves near base, blades cut, inflorescence a spike, unbranched, enlarged, fruit black, forest and borders of swamps, vicinity Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24117.* French Guiana.

Geonoma Maguirei Bailey, sp. nov. (Fig. 5.) Humilis, gracilis, 5 dm. alta, glabra, inermis; folia parva, densa, simplicia, 16–18 cm. longa, 6–8 cm. lata, a latere multinervata ex costa media, angustata ad basin, bilobata apice, lobi 4–5 cm. longi, divaricati et valde acuti; inflorescentia erecta in axillis petiolorum lata basi, axes simplices et 2–3 cm. longi, spatha invisa; flores unici vel aliquid aggregati, dentati apice; fructus latoconici, circa 1 cm. longi, caeruleo-nigri.

Long very slender stem below the crowded crown of foliage, 5 dm. tall, glabrous, unarmed; leaves small, crowded, simple, 16–18 cm. long, 6–8 cm. broad, laterally many-nerved from midrib, narrowed to base, bilobed at apex, lobes 4–5 cm. long, divaricate and very acute; inflorescence erect in axils of

[21] By L. H. Bailey.

broad-based petioles, axes simple and 2–3 cm. long, spathes unknown; flowers single or somewhat aggregated, dentate at apex; fruit broad-conic, about 1 cm. long, blue-black.

FIG. 5. *Geonoma Maguirei* Bailey. *Maguire 24166.* × ⅓.

TYPE: infrequent, slender cane, 5 dm. tall, fruit blue-black, low forest, line beyond Pakira Camp (4), Coppenam River Headwaters, Surinam, July 24, 1944, *Maguire 24166.* New York Botanical Garden.

This plant differs from *Geonoma stricta* in its smaller less rigid stature, thinner and less nodose caudex, relatively shorter and broader leaves, and petiole bases not strigose.

GEONOMA BACULIFERA (Poit.) Kunth. SURINAM: abundant, stem to 2 m. high, leaves terminal at summit of cane, dominant in pine forest and swamps, Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24094;* locally abundant, caned leaves not cut, swamps along km. 14, between Kwatta and Pakira Camps (3 and 4), Coppenam River Headwaters, *24154.* French, Dutch, and British Guiana, Venezuela.

GEONOMA affin. *G.* VAGA Griseb. & Wendl. BRITISH GUIANA: frequent, banks and swamps along Kamuni Creek, Groete Creek, Essequibo River, *22939.* It will require much more material (including fully mature fruit) before the merits of *G. vaga, G. pinnatifrons,* and *G. binervia* can be made out.

Geonoma saramaccana Bailey, sp. nov. (Fig. 6.) Humilis, caulis brevis non arboreus, inermis, glaber; folia simplicia vel fortasse scissa ad basin, paene vel admodum .5 m. longa et 12–14 cm. lata, bilobata apice circa 15 cm. profunda, lobi acutissimi, fastigati ad basin, nervi laterales multi validique; inflorescentia erecto-divaricata ex axillis, pedunculus teres et 16–20 cm. longus, rami 3 vel 4, 15–18 cm. longi, spathae non evidentes; flores parce inserti, 5–10 mm. inter se; fructus globulares, nigri, 6–7 mm. diam.

Low palm with leaves all basal, perhaps not exceeding 1 m. in height, not arboreous, unarmed, glabrous; leaves simple or perhaps split toward base, nearly or quite .5 m. long and 12–14 cm. broad, bilobed at apex about 15 cm. deep, lobes very acute, tapering to base, lateral veins many and strong; inflorescence erect-divaricate from axils, peduncle terete and 16–20 cm. long, branches 3 or 4, 15–18 cm. long, spathes not evident; flowers scarcely imbedded, 5–10 mm. asunder; fruit globular, black, 6–7 mm. diam.

TYPE: infrequent, leaves basal, stem short, in swamp, Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, Surinam, July 9, 1944, *Maguire 24095.* New York Botanical Garden.

YUYBA, Bailey, Gent. Herb. **7**: 413. 1947. *Amylocarpus* Barb.-Rodr. Contrib. Jard. Bot. Rio de Janeiro, **3**: 69 (1902), non Currey, 1857. This is a new generic name to replace *Amylocarpus* of Barbosa Rodrigues, a name disqualified by the fungus *Amylocarpus* of Currey (1857), as stated by Drude in Engler & Prantl, *Pflanzenfamilien,* Nachtrag **3**: 28; Drude states that *Amylocarpus* Barb.-Rodr. must be displaced but does not propose a new generic name. Since Drude's time the genus has been merged in *Bactris,* with confusion. I have long held the genus to be distinct and with sound characters of separation, but have not written on these palms until recently.

Barbosa divides his genus *Amylocarpus* into two sections, *Marayarana* and *Yuyba,* which latter in English I pronounce "Yuee-ba." The first section includes palms with bifid or furcate leaves and the second those with leaves more or less pinnatisect or pinnate. They are all little understory palms, some of them devoid of prickles or pricklets, heretofore recognized as Brazilian.

Barbosa does not indicate a type for his genus *Amylocarpus.* In my treatment of the genus, under the name *Yuyba,* I assume *Bactris simplicifrons* of Martius as typical. The genus appears not to be homogeneous, and as material accumulates we may be under the necessity of dividing it.

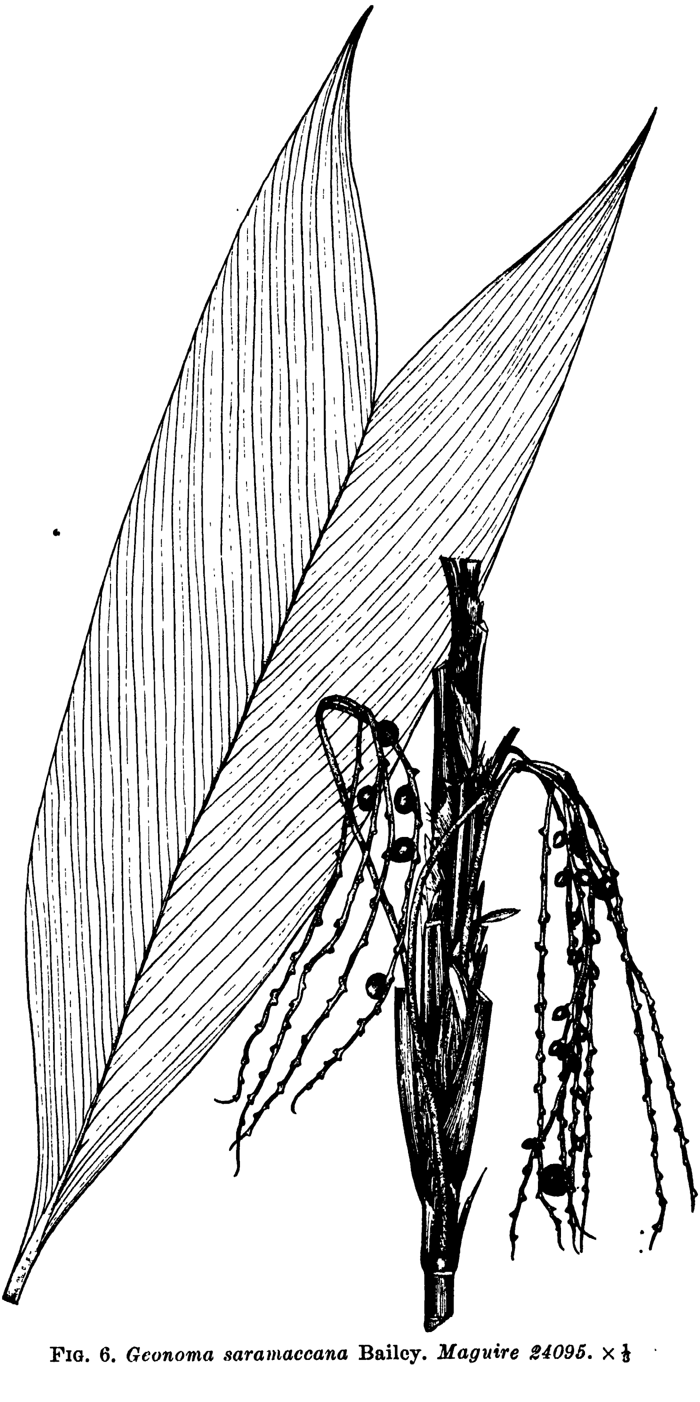

FIG. 6. *Geonoma saramaccana* Bailey. *Maguire 24095.* × ⅓

Technical marks of the genus *Yuyba* are the low stature, parts all small, often wholly unarmed and never heavily spiny; spathes infrafoliar, only 9 cm. or less long, very narrow, unarmed, spadix short and strongly decurved on a stout short downwardly curved peduncle 6–8 cm. or less long, of a single, duplicate or triplicate axis; stamens 6 attached to base of petals; calyx and corolla urceolate or cylindric, forming a tube briefly dentate at apex; fruit very small and usually unarmed, mostly scarlet at full maturity.

Key to species known in Surinam

A. Leaves pinnate.
  B. Stem (or trunk) spiniferous on upper part; leaves opaque or dull in color. — *Y. Maguirei.*
  BB. Stem unarmed; leaves distinctly glossy. — *Y. Stahelii.*
AA. Leaves simple and bifurcate; bifurcation very deep, extending to top of petiole.
  B. Lobes of leaf 7–8 cm. broad, very glossy. — *Y. dakamana.*
  BB. Lobes of leaf 10–12 cm. broad, dull in texture. — *Y. essequiboensis.*

Yuyba Maguirei Bailey, sp. nov. (Fig. 7.) Erecta ad 2 m., tantummodo aculeis piliformibus in parte superiore, caulis circa 1 cm. diam.; folium (praeter petiolum) circa 20 cm. longum et latum, glabrum, tenue; pinnae 5–7 in utroque latere non semper oppositae, longo-lanceolatae gracile apice curvo, 18 cm. longae, 2–3 cm. latae, costae 1–3, nervi intermedii pauci; inflorescentiae 3–6 cm. longae, mox pendentes, in axillis, rachis unica et simplex ramulis lateralibus brevibus floribus spissis petalis et sepalibus attenuatis; spatha postea emergens, 4–5 cm. longa et mox in partes longitudinales divisa; fructus pauci in pedunculo curvo, circa 1 cm. longi et crassi, rostrati; semen unicum, solidum, albumen homogeneum.

Pinnate-leaved, to 2 m. tall, erect; stem nearly or quite 1 cm. thick, bearing toward the top a few very weak soft not sharp or prickly spine-like hairs 2 cm. or less long; petiole slender, 2-edged and ribbed, with prickle-like hairs at base; leaf-blade to 30 cm. long and nearly of equal breadth, glabrous, thin; pinnae 5–7 on either side but not all opposite, long-lanceolate and curved taper-pointed, to 18 cm. long and 2–3 cm. broad at middle, midrib prominent but not always central, secondary ribs 1 or 2; flower-cluster 3–6 cm. long, soon hanging, emerging from an axil, rachis single and simple but bearing lateral branchlets of crowded flowers with sharp-pointed chaffy perianth parts, producing only a few fruits; spathe emerging later, 4–5 cm. long but soon splitting into shreds, in fruit the cluster on a stout downward-crooked peduncle; fruit drupe-like, almost globular with a short beak, nearly or quite 1 cm. thick in either direction, filled with a homogeneous seed.

Type: frequent, 1.5–2 m. high, precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, Surinam, August 29, 1944, *Maguire 24555*. Bailey Hortorium; isotype: New York Botanical Garden.

Yuyba Stahelii Bailey, sp. nov. (Fig. 8.) Erecta ad 1.5 m., inermis, glabra, caulis circa 1 cm. diam.; folium (praeter valde longum petiolum) 30 cm. et minus longum et paene aeque latum, tenue, nitidum; pinnae 3–4 vel 5 in utroque latere sed non omnes oppositae, longo-lanceolatae, 18–20 cm. longae et 2–4 cm. latae, par terminale saepe 6–8 cm. latum, costae paucae et non confertae; inflorescentia circa 3 cm. longa cum matura, divaricata vel deflexa, axes 2, flores congesti; spatha angusta, glabra, circa 5 cm. longa; fructus multi et spissi, circa 5 cm. longi (immaturi) et rostrati.

FIG. 7. *Yuyba Maguirei* Bailey. *Maguire 24555.* × ⅓.

Pinnate-leaved, erect, 1–1.5 m. tall, unarmed, stem about 1 cm. thick; petiole very long and slender, often 30 cm. and more, ridged; leaf-blade 30 cm. and less long, thin, glossy; pinnae 3–4 or 5 on either side but not all opposite, long-lanceolate with curved slender point, 18–20 cm. long, 2–4 cm. broad at middle but the terminal pair often 6–8 cm. broad, main ribs 1–several; clusters about 3 cm. long at maturity, divaricate or down-curved in fruit, flowers in dense little clumps, main axes 2, emerging narrow glabrous spathe eventually about 5 cm. long and declined; fruit freely produced, pointed, about 5 mm. long but not yet mature.

TYPE: in coastal region, Zanderij, Surinam, *Dr. Gerold Stahel,* sine no. Bailey Hortorium; isotype: New York Botanical Garden.

Yuyba dakamana Bailey, sp. nov. (Fig. 9.) Valde gracilis, fortasse 1 m. alta, debiliter aculeata in parte superiore et petiolis, caulis minus quam 1 cm. diam.; folium tenue, nitidum, profunde bifurcatum, folia inferiore tota, lobi terminales circa 30 cm. longi et 7–8 cm. lati, 7-nervati, apex acutus, petiolus ad 18 cm. longus, porriginosus et spinescens; inflorescentia deflexa, axis unicus circa 6 cm. longus, pedunculus validus curvusque, spatha ad 9 cm. longa et 1 cm. lata, acuta; flores unici et non aggregati, tubulares, dentati apice; fructus invisi.

Very slender, weakly prickly on upper part and petioles, perhaps 1 m. tall, stem less than 1 cm. thick; leaf thin, bifurcate or the lower ones entire, glabrous, shining, each of the 2 lobes nearly or about 30 cm. long, 7–8 cm. broad, strongly about 7-nerved, apex acute, petiole to 18 cm. long, scurfy and spinescent; inflorescence pendent from a stout curved peduncle, axis single about 6 cm. long, spathe to 9 cm. long and 1 cm. broad and acute; flowers single, tubular, dentate at apex; fruit unseen.

TYPE: in dakama bush at bottom of Arrowhead Basin, Tafelberg, Surinam, September 3, 1944, *Maguire 24614.* Bailey Hortorium; isotype: New York Botanical Garden.

Yuyba essequiboensis Bailey, sp. nov. (Fig. 10.) Erecta ad 1.5 m. alta, glabra, inermis, caulis 1 cm. vel plus diam.; petiolus 12–15 cm. longus, costatus; folium (praeter petiolum) 30 cm. vel plus latum et paene aeque longum, 2 lobis terminalibus, costae maximae 7 vel 8 nervis tenuibus inter eas, brevius acutae; spatha divaricata vel deflexa, straminea, 5–6 cm. longa, circa 1 cm. lata, acuminata; axis spadicis unicus, pedunculus validus curvusque; flores unici, tubulares, dentati apice; fructus invisi.

Bifurcate-leaved, to 1.5 m. tall, glabrous, unarmed, stem with sheaths 1 cm. or more thick; petiole relatively short, to 12–15 cm. long, ribbed; leaf-blade large, thickish, or 2 broad diverging lobes each about 30 cm. long and 10 cm. broad, with 7 or 8 main lengthwise ribs and fine veins between, apex running to a brief point; spathe 5–6 cm. long, tawny when dry and glabrous, about 1 cm. broad and pointed, divaricate or becoming deflexed; axis of spadix single, soon pendent with stout curved peduncle; flowers single rather than bunched, tubular, dentate at apex, stramineous; fruit not seen.

TYPE: infrequent, to 1.5 m. high, swampy area, in mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, British Guiana, April 14, 1944, *Maguire & Fanshawe 22835.* New York Botanical Garden.

Desmoncus Maguirei Bailey, sp. nov. (Fig. 11.) Scandens circa 4 paribus retrorsonum uncorum rigidorum 3 cm. vel plus longorum; caules vaginaeque circumdata aculeis bulbosis 15 mm. vel minus longis; folia 15 dm.

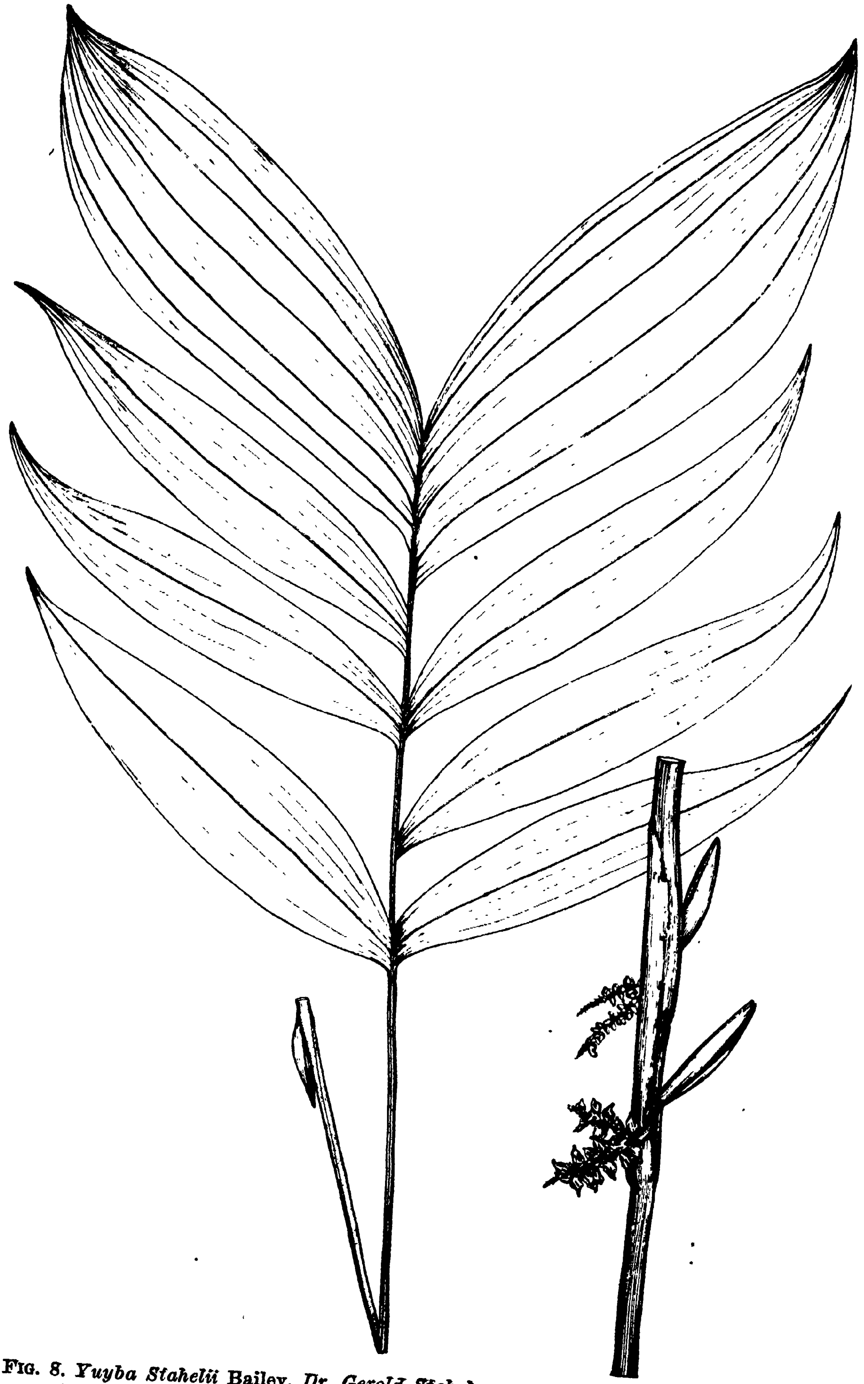

FIG. 8. *Yuyba Stahelii* Bailey. *Dr. Gerold Stahel*, coastal region, Zanderij, Surinam, sine no. × ⅓.

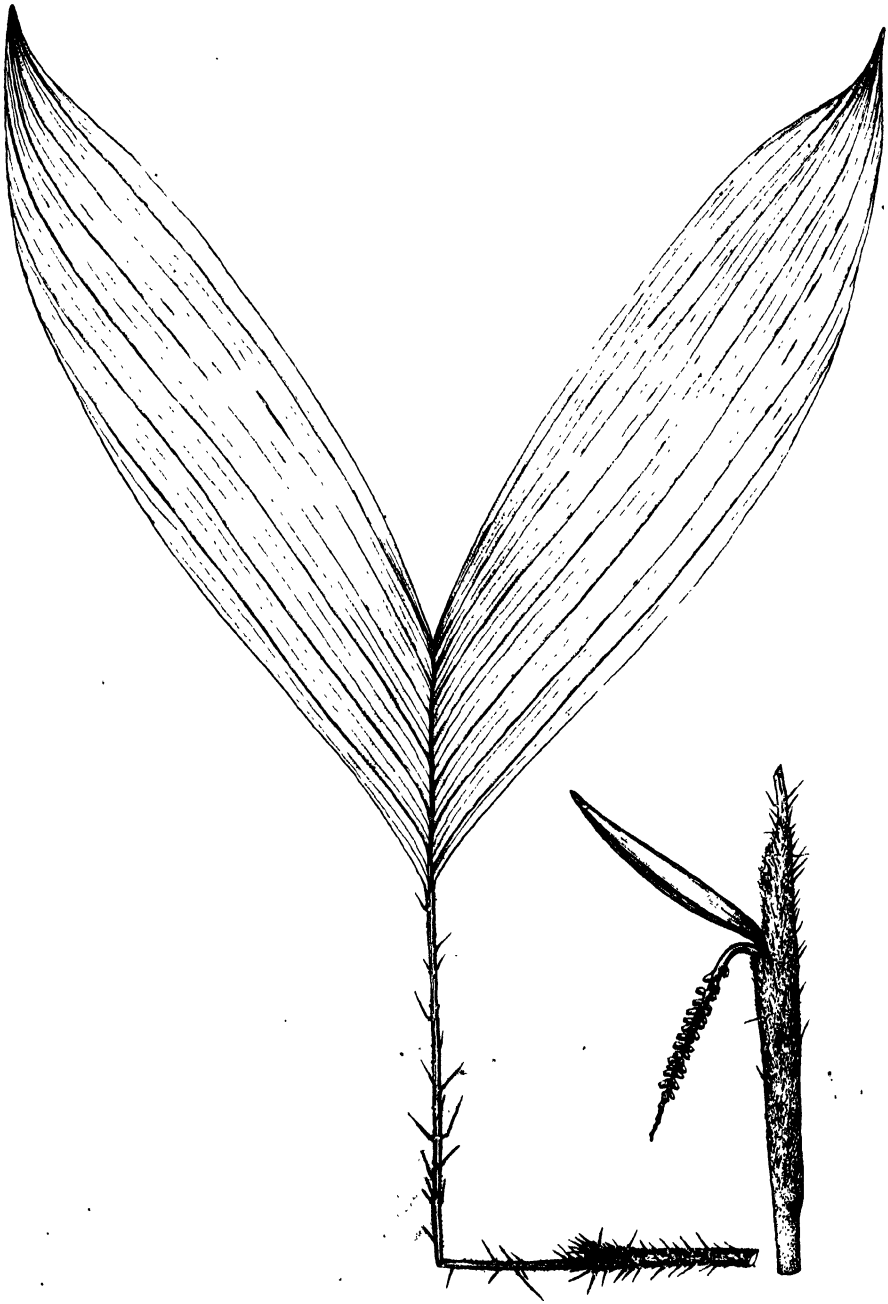

FIG. 9. *Yuyba dakamana* Bailey. *Maguire 24614.* × ⅓.

vel plus longa, pinnata; pinnae non omnes oppositae, angustae, longo-acuminatae, ad 15 cm. longae, 3–4 cm. latae, inermes praeter ad basin, rachis

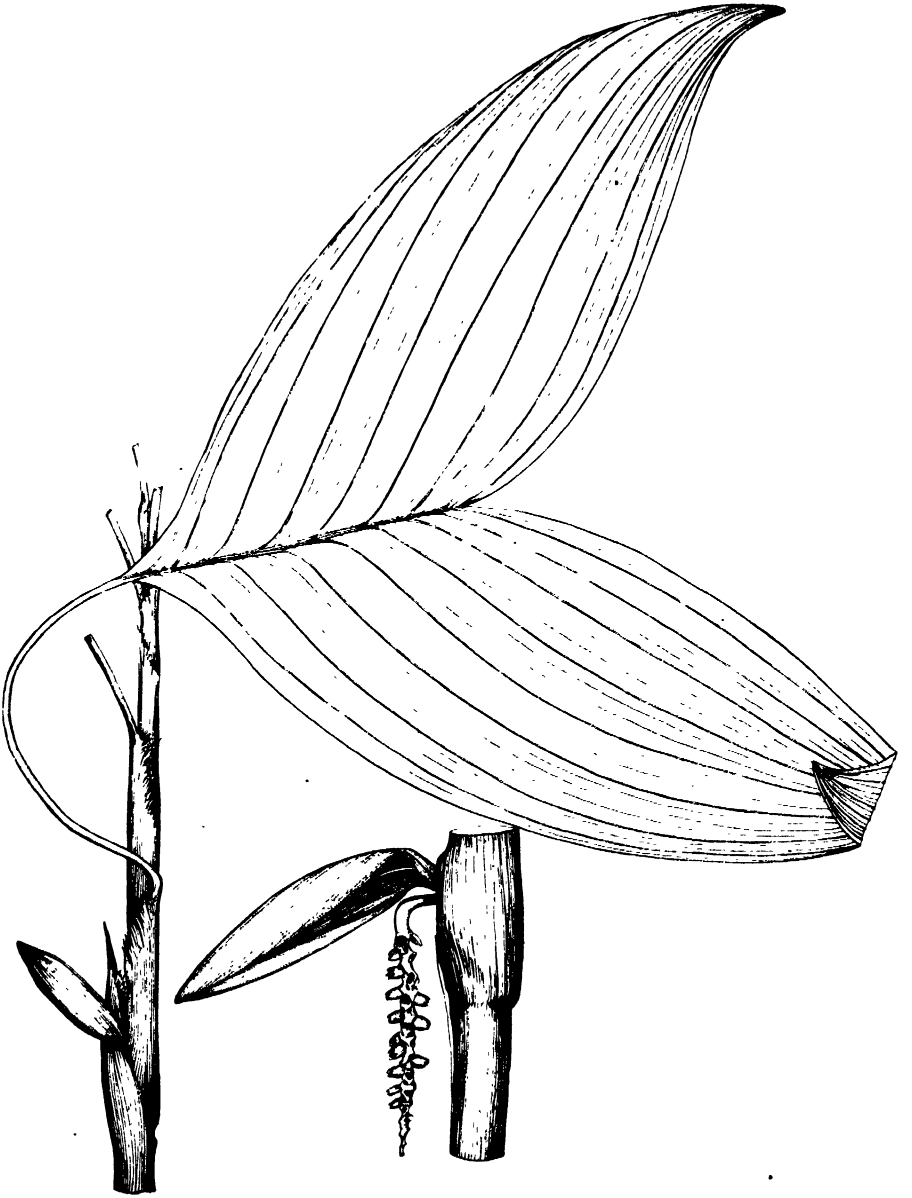

FIG. 10. *Yuba essequiboensis* Bailey. *Maguire & Fanshawe 22835.* × ⅓.

armata uncis brevissimus; spatha cylindracea, 25 cm. vel plus longa, 15 mm. crassa, brunneus, bulbosis uncis declinatis consita 5 mm. vel minus longis.

FIG. 11. *Desmoncus Maguirei* Bailey. *Maguire & Stahel 25011.* × $\frac{1}{3}$.

FIG. 12. *Desmoncus kaieteurensis* Bailey. *Maguire & Fanshawe 23093.* × ⅓

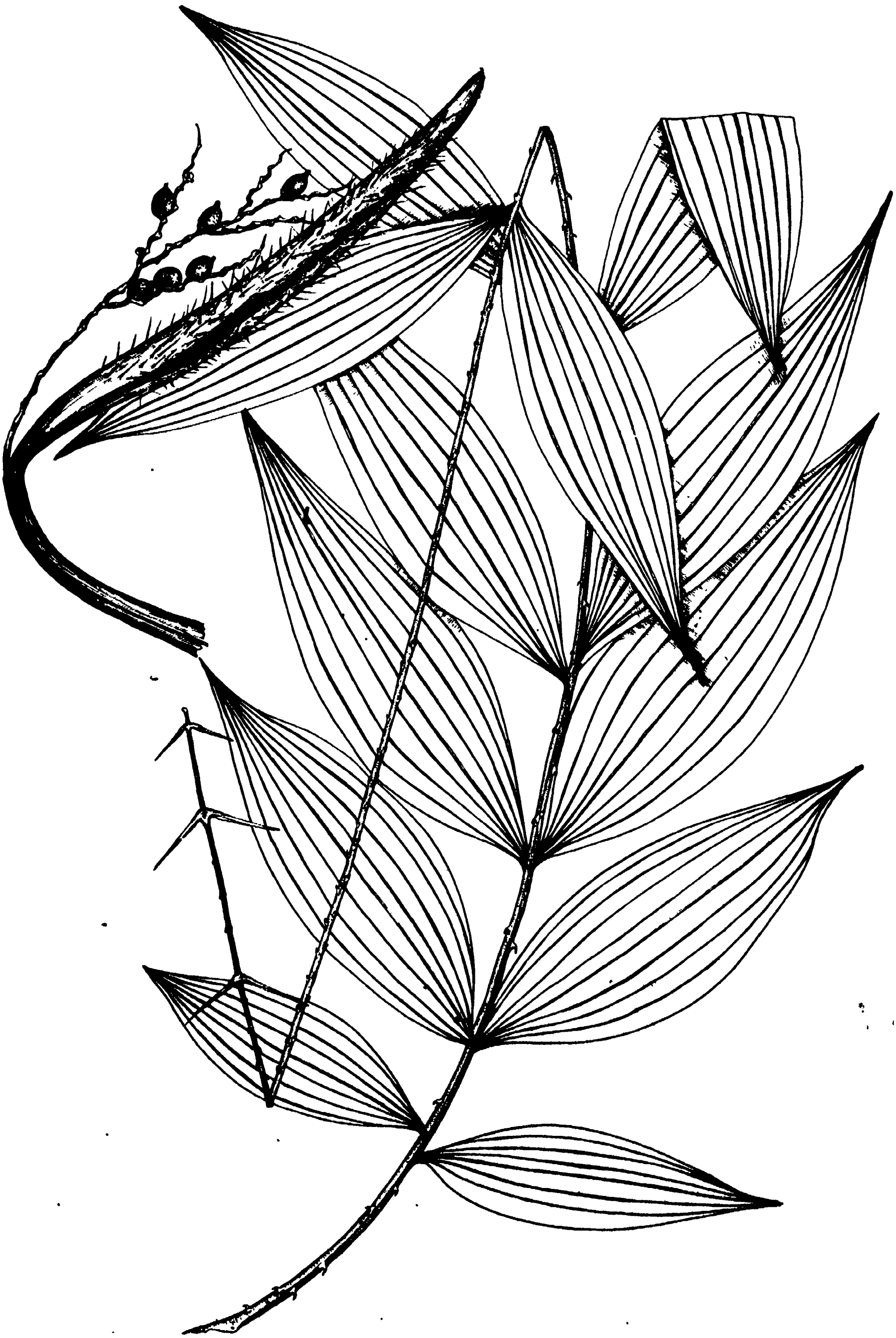

FIG. 13. *Desmoncus parvulus* Bailey. *Gleason 164.* × ⅓.

Climber with about 4 pairs of retrorse stiff hooks 3 cm. or more long; stem and sheaths beset with bulbose prickles 15 mm. and less long; leaves 15 dm. or more long, pinnate; pinnae not all opposite, narrow, long-acuminate, to 15 cm. long, 3–4 cm. broad, unarmed except near base, rachis armed with very short hooks; spathe cylindric, 25 cm. and more long, 15 mm. thick, brown, covered with bulbose declined hooks 5 mm. and less long.

TYPE: in second-growth jungle known to natives as "bamba maka," Kwakoegron, Surinam, October 19, 1944, *Maguire & Stahel 25011*. Bailey Hortorium; isotype: New York Botanical Garden.

Desmoncus kaieteurensis Bailey, sp. nov. (Fig. 12.) Scandens; folia pinnati, uncorum pauca paria, gracilia, 3 cm. vel minus longa, rachis multis uncis minimus 1 mm. vel plus longis; pinnae non omnes oppositae, lato-ellipticae, breviter sed conspicue acuminatae, angustae basi, inermes, 15 cm. vel minus longae, 5 cm. latae; inflorescentia brevis, simpliciter ramosa, 7–8 cm. longa; spatha cylindracea, 9–10 cm. longa, multis pilis bulbosis mollibusque 3 cm. vel minus longis; fructus rufi, globosi, circa 1 cm. diam.

Climber; leaves about 7 dm. long, pinnate, hooks a few pairs, slender, 3 cm. or less long, rachis with many very small hooks 1 mm. and more long; pinnae not all opposite, broad-elliptic, briefly but conspicuously pointed, narrow at base; unarmed, 15 cm. or less long, 5 cm. broad; inflorescence short, simply branched, 7–8 cm. long; spathe cylindric, 9–10 cm. long, with many bulbose soft hairs 3 cm. or less long; fruit red, globose, about 1 cm. diam.

TYPE: locally frequent, climbing palm, midrib continued above leaflets, hooked and barbed, fruit globose, red, secondary forest, trail from Tukeit to Kaiatuk Plateau, British Guiana, April 29, 1944, *Maguire & Fanshawe 23093*. Bailey Hortorium; isotype: New York Botanical Garden.

Desmoncus parvulus Bailey, sp. nov. (Fig. 13.) Probabiliter parva et gracilis; pinnae 6–8 paribus, paene vel admodum oppositae, breves lataeque, 15–20 cm. longae, 3–5 cm. latae, breviter acutae ad apicem basinque, sine spinis; petiolus rachisque paucis parvis spinis curvis 1–3 mm. longis, unci parvi debilesque, 2 cm. vel minus longi; spatha parva angustaque, cylindracea, spinis brevibus basi crassa; fructus oblongo-acuminati, circa 15 mm. longi.

Probably small and slender; pinnae 6–8 pairs, nearly or quite opposite, short and broad, 15–20 cm. long, 3–5 cm. wide, briefly acute to apex and base, spineless; petiole and rachis with few small curved spines 1–3 mm. long, hooks small and weak, 2 cm. or less long; spathe small and narrow, cylindric, covered with thick-based short spines; fruit oblong-pointed, about 15 mm. long.

TYPE: in dense upland forest, Tumatumari British Guiana, *Gleason 164*. New York Botanical Garden.

The species is apparently close to *D. kaieteurensis*, but leaflets are much narrower and long-acuminate, more strongly nerved, hooks more divaricate, spathe with stouter armature, fruits (immature) elongate rather than globular.

Gen. et sp. indet. SURINAM: frequent, low-growing, 1 m. high, in low forest, vicinity Black Water Camp (5), Coppenam River Headwaters, *24178*. Probably a new genus, but no flowers, no filled-out fruits.

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TORREYA

Measurements of the Annual Growth-Rate of Two Species of Rock Lichens. During the years 1939 to 1947, on or about the first of July of each year, my husband and I made measurements of the annual growth-rate of two species of rock lichens, one growing on the upper slopes and the other near the summit of Mt. Monadnock, in the southern part of New Hampshire. The first species was the ring lichen (*Parmelia centrifuga*); and the second was the green map lichen (*Rhizocarpon geographicum*).

Parmelia centrifuga was represented by three isolated plants growing on an exposed ledge of mica schist on the southwest slope of the mountain at an elevation of about 2,170 feet. The plants were shaded during the first half of the day by a clump of red spruce, but exposed to the full sunlight during the last half of the day. At this elevation there is found, growing together with *Parmelia centrifuga,* a closely allied species, *P. conspersa*. The three plants of *P. centrifuga* were meas-

TABLE 1. *Annual growth of lichens in millimeters.*

Parmelia centrifuga	Diameter in 1939 in mm.	1939 to 1940	1940 to 1941	1941 to 1942	1942 to 1943	1943 to 1944	1944 to 1945	1945 to 1946
Plant No. 1	11.0	0	1.5	2.5	0	1.0	1.0	1.5
Plant No. 2	5.0	1.0	0.5	2.0	1.0	0.5	1.0	0.5
Plant No. 3	16.0	1.0	0	1.0	0	1.0	0.5	0.5
Rhizocarpon geographicum	in 1942 31.0	...	...	...	1.0	0.55	0.6	0.75

ured with a steel millimeter rule, laid along the major axis of each plant, between small drill holes in the rock, thus insuring that the annual measurements were made along exactly the same lines. The measurements were made on the first, or during the first week, of July each year.

The single plant of the green map lichen (*Rhizocarpon geographicum*) was similarly measured some time during the first two weeks of each July from 1942 to 1946, giving four year-periods. This plant grew on an exposed ledge of rock of extremely firm and compact mica schist (more like a grayish quartzite) at an elevation of 3,010 feet, near the summit of the mountain, entirely open at all times of day to the sun, and with a steep south slope. The record of the measurements of all four plants is given in table 1.

The average annual growth of the three plants of *Parmelia centrifuga* over a seven-year period was 0.85 mm. and that of the one plant of *Rhizocarpon geographicum* over a four-year period was 0.72 mm. It will be noted from the table that there was more growth of two of the plants of *Parmelia centrifuga* in 1941–42 than in any other year for which measurements were made. The growth of the third plant was as great as that in any year, and greater than most of the measurements.

This may have been because the mountain was (or seemed to be, without the backing of any precise data on the subject) more swathed in clouds than in other summers. I remember that there were many days in succession when climbers were "house-bound" because of the dense cloud on the mountain.

The three plants of *Parmelia centrifuga* grew where they were partially shaded a good deal of the day; the temperature of the surface of the rock whereon they grew never exceeded (by our records) about 115° F. Being partly sheltered by spruce prevented them from drying out for long periods of time. Nor were they, in their protected situation, blown over by cold winter winds, nor left exposed during the entire winter without a blanket of snow or ice.

The plant of *Rhizocarpon geographicum*, however, was exposed to the sun at all times; the temperature of the adjacent rock-surface measured (on one occasion) 144° F.—hotter than the hand could bear with any comfort. This must be a common condition. The plant at this time (or one nearby) seemed as dry as powder. During the winter no snow could accumulate on the steep, smooth, rock surface on which the plant grew. It was therefore exposed to temperatures far below zero. (At our farm-house, 9 miles distant, winter temperatures of −46° F. were common). These extremes of heat and cold and of desiccation, meant that there were periods, perhaps long ones, when the plant existed statically, without growth.

The largest plant of *Rhizocarpon geographicum* which we found on this mountain (3,166 ft. altitude), also fully exposed, measured about 86 mm. in diameter. Supposing the rate of growth of such plants to be roughly the same in the same situations, we computed the age of this plant to be about 120 years. If lichens of this same general nature (as *Parmelia centrifuga, P. conspersa, Rhizocarpon geographicum*, and *Lecidea cyanea*) increase in diameter in the order of magnitude suggested by these records, then some much larger ones, in higher mountains where the growth-rate must be much more retarded, must be thousands of years in age. In old plants the central tissues of the disc (the first ones) have disappeared, leaving only a large ring of growing tissue.

Studies of the growth of some of the lichen-patches on Mt. Washington, and on the higher mountains of the West, would be most interesting.—ETHEL HINCKLEY HAUSMAN.

REVIEWS

North American Species of Mycena. By Alexander H. Smith. i–xviii, 1–521. *f. 1–56, pl. 1–99.* Ann Arbor: University of Michigan Press; London: Geoffrey Cumberlege, Oxford University Press. 1947.

It is needless to say that original taxonomic monographs based on a broad approach, not excluding comparative cytology, anatomy, chemical characters and ecology of the organisms studied, are presently the most urgently needed contributions in the field of cryptogamic botany. Smith's *Mycena* book is, in spite of its modest title, a monograph of this sort and will be invaluable to American as well as foreign mycologists. The reviewer no less than others who have been endeavoring in similar original studies can appreciate the immense amount of work that has been necessary to assemble and reassemble the innumerable facts presented in the 232 complete de-

scriptions, the notes on various other species, the 56 anatomical figures and the 99 plates reproducing the author's photographs of fresh material. The author has, in earlier papers, pioneered in the cytological study of the genus Mycena, and has now introduced into his descriptions a very careful study of the anatomy of the various parts of the carpophores and the iodine reaction of the spore walls and tissues. His keys are very clear and can be used advantageously by discriminating, trained students.

Some taxonomists might be inclined to criticize Smith's extremely broad concept of the genus *Mycena,* a concept much broader than that of Fries and the classical school, but nearly coinciding with that of the author of a previous monograph, R. Kühner. However, in the reviewer's opinion this broad concept is a progress rather than a regress since both these monographers have noticed the affinities of the various groups combined in *Mycena sensu* Fries with species formerly dispersed all over the Agaricales, whereby it appeared impossible to separate these species generically from elements now usually considered as true Mycenas. The only alternative would have been the partition of the genus, *i.e.* the admission of several smaller genera instead of a single one, a solution which the author was not quite ready to adopt. Some remarks in the book lead one to assume that the author's aim was a monograph of the species referable to the *facies* Mycena rather than to the systematic-nomenclatural unit Mycena. If the reviewer has understood this attitude correctly, he is inclined to believe that Smith's conception of *Mycena* was proper in view of the personal interpretation he gave to his problem.

Another point that might perhaps be criticized is the minimizing of the microchemical characters,—in this case in vivid contrast to the views of the author's predecessor, Kühner, whose classification is mainly based on differences in the iodine reaction and metachromatism in cresyl blue stains. While admitting that the iodine reaction is a character of major importance, Smith goes on the declare "I have minimized its use . . . because of the difficulty of determining it on fresh material. It is a character of considerable value to the specialist, but one likely to be difficult for the beginner to interpret." While this point of view may be reasonable or at least defendable, the reviewer fails to see why it should have influenced questions of taxonomy and affinity. In fact, it cannot be denied that certain sections such as the *Deminutivae,* are based on rather weak characters, and would naturally fall apart if treated with less respect for the fallacies of the beginner. On the other hand, it must be recognized that the inclusion of certain species with unknown iodine reaction [e.gr. *Mycena minutula* (Peck) Sacc.] seems to be desirable for reasons of floristic completeness, and an emphasis on microchemical reactions would have made their inclusion impossible.

It would be unreasonable to expect that in the course of admitting or rejecting some 500 binomials, the author should have always decided in favor of a name acceptable to *all* other mycologists. This is not the fault of any specialist but of the state of botanical nomenclature whose rules are at present not quite explicit enough to eliminate personal preferences of the monographer. For instance, the reviewer would have preferred the proposal of a few *nomina nova* to somewhat precarious interpretations of European species, especially those not proved to occur in both continents. However, the author has never disregarded the International Rules, an attitude that

tends to make his nomenclature less vulnerable to future readjustments than that of many other contemporary authors.

The book contains a definition of the genus *Mycena*, a short history of past research on *Mycena* in North America, a valuable discussion of all diagnostic characters, a review of the accepted classification (the author divides *Mycena* into 17 sections and a number of subsections and *stirpes* which are grouped within the 4 main subgenera: *Pseudomycena, Eumycena, Glutinipes* and *Mycenella*), and a complete taxonomic treatment of the temperate and some subtropical species. The majority of the tropical and subtropical and also all the excluded and doubtful species are treated in supplements which contain very interesting information on type material. The use of the *stirps* as a taxonomic entity reuniting a group of obviously closely related species has been adopted from the French mycologists. Its use in fungus-monographs, especially of large genera, has definite theoretical and practical advantages.

The illustrations are plentiful and, as always in Smith's papers, excellent.—ROLF SINGER.

Origins of the Flora of California. By Douglas H. Campbell and Ira L. Wiggins. Stanford University Publications, University Series, Biological Sciences **10**: 3–20. 1947.

The fact that "California is unique in its almost complete phytogeographic isolation" is attributed by the authors not primarily to the felicitous climate (!) but to the events of geological history which have effectively separated the area from the rest of the United States since Cretaceous time. The unusual diversity in climate (temperature, quantity and seasonal distribution of rainfall) and topographic relief have, of course, contributed markedly to the present multiplicity of species. Even by conservative estimates the number of species and varieties in the area exceeds that included in the seventh edition of *Gray's Manual*, and has been estimated to approach five thousand. There thus appears to be justification in concluding that this is "a separate botanical province, comparable with such areas as the Iberian Peninsula, certain other Mediterranean regions, the Cape region of South Africa, or Western Australia." With migration from the east barred since the Cretaceous by a cordilleran and climatic Iron Curtain, the various components of the flora are believed to have entered their present stations principally from the north (circumboreal, eastern American, and Asiatic elements) and from the south (Mexican, Central American, and temperate South American types) by way of the Coast Ranges and the Sierra Nevada.

Some thirty-six percent of the species and varieties inhabiting California are construed as endemic, and the old dichotomy of "relictual" versus "beginning" species is reintroduced. No mention is made of Mason's effective correlation of a considerable sector of the endemics with edaphic factors (*Madroño* **8**: 209–226, 241–257. 1946), the case of the serpentinophiles in the area being one of the most striking. Of the genera listed as being particularly rich in local species in California, it is difficult to know how much of the endemism to attribute to the plants, and how much to the taxonomists. The conclusion that the majority of the endemics have originated in their present area has much to recommend it, including common sense.

Campbell and Wiggins, although introducing few new concepts or explanations,

have written a concise and highly readable account of the development of the present flora of California, which will enable the outlander to understand better the problems confronting Pacific Coast botanists, and may give needed orientation even to workers within that area.—LINCOLN CONSTANCE.

NEWS NOTES

Last year the Board of Regents of the University of Minnesota accepted a gift of $15,000 to establish "The Conway MacMillan Memorial Research Fellowship in Botany, Charles J. Brand, 1902, Founder," with an annual stipend of $1,200. Mr. Brand plans to add to the fund, and hopes to interest other men and women who were trained by Professor MacMillan in making the fellowship permanent. Professor MacMillan was head of the Department of Botany at the University of Minnesota from 1891 to 1906. During that time he published a number of books on Minnesota plants and initiated a series of studies on different groups of Minnesota plants which were carried out and published by his students. To be eligible for this fellowship a student must be a doctoral candidate at the University of Minnesota and have a master's degree.

The Save-the-Redwoods League is launching a campaign for membership and increased public participation in its program. According to the new annual report of the League, "All the world hails the majesty and grandeur of the primeval forests of Sequoia sempervirens. It comes as a shock to many to realize that unless the program of the Save-the-Redwoods League is fully successful some of the finest of these Redwood forests are in danger of being destroyed, for they are in the path of lumbering operations." The Treasurer, to whom contributions to the Save-the-Redwoods League may be sent, is Dr. Robert Gordon Sproul, 250 Administration Building, University of California, Berkeley 4, California.

The Editor announces that a new *Memoir* of the Torrey Botanical Club, Vol. 20, No. 2, will be published early in 1948. It is by Robert L. Lowry (Michigan State College), "A Cytotaxonomic Study of the Genus *Mnium*." It will contain taxonomic descriptions of the species of *Mnium*, an account of their chromosomes, and a discussion of their relationships. About 50 pages. Illustrated. Price $1.50.

INDEX TO AMERICAN BOTANICAL LITERATURE

COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used to include the entire Western Hemisphere.

Papers that relate exclusively to bacteriology, forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included. If users of the Index will call the attention of the Bibliographer to errors or omissions, their kindness will be appreciated.

The Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of three cents for each card. The different subjects as classified below may be ordered separately (but no orders will be taken for less than one year's issue in any classification). Correspondence relating to the card issue should be addressed to the Treasurer of the Club.

TAXONOMY, PHYLOGENY AND FLORISTICS

ALGAE

Abbott, Isabella A. Brackish-water algae from the Hawaiian Islands. Pacif. Sci. **1**: 193–214. *f. 1–13.* O 1947.

Brunel, Jules. *Vaucheria Schleicheri* in North America. Contr. Gray Herb. **165**: 62–69. *f. 1, 2 + table 1.* 6 O 1947.

Dawson, E. Yale. A guide to the literature and distributions of the marine algae of the Pacific Coast of North America. Mem. So. Cal. Acad. **3**: 1–134. 1946 [Ja 1947].

Dawson, E. Yale. Lista de las algas marinas de la costa pacifica de Mexico. Revista Soc. Mex. Hist. Nat. **7**: 167–215. D 1946.

Fritsch, F. E. The structure and reproduction of the algae. II. [Phaeophyceae, Rhodophyceae, Myxophyceae]. *i–xiv,* 1–939. *front., f. 1–336, 2 maps.* Cambridge. 1945.

Papenfuss, George F. Extension of the brown algal order Dictyosiphonales to include the Punctariales. Bull. Torrey Club **74**: 398–402. S 1947.

Sanborn, Ethel I. & Doty, Maxwell S. The marine algae of the Coos Bay—Cape Arago region of Oregon. Oregon St. Monogr. Stud. Bot. **8**: 1–66. *pl. 1–4 + tables 1–4.* O 1944 [1947].

Williams, Louis G. & Blomquist, H. L. A collection of marine algae from Brazil. Bull. Torrey Club **74**: 383–397. *f. 1–3.* S 1947.

FUNGI AND LICHENS

Antikajian, Grace. *Rhizophydium chitinophilum.* Mycologia **39**: 612–616. *f. 1–20.* S 1947.

Des Abbayes, H. Contributions a l'étude des lichens des îles Hawaii: *Cladonia* récoltés en 1909–1910 par l'Abbé Faurie. Bull. Mus. Hist. Nat. [Paris] II. **19**: 105–117. *f. 1, 2.* Ja 1947.

Dolan, Desmond. A new anthracnose on melons [*Marssonia melonis* n. sp.]. Phytopathology **37**: 583–596. *f. 1–4 + tables 1–6.* Au 1947.

Drechsler, Charles. A *Basidiobolus* producing elongated secondary conidia with adhesive beaks. Bull. Torrey Club **74**: 403–413. *f. 1–22.* S 1947.

Dulaney, Eugene L. Penicillin production by the *Aspergillus nidulans* group. Mycologia **39**: 582–586. *tables 1, 2.* S 1947.

Dulaney, Eugene L. Some aspects of penicillin production by *Aspergillus nidulans*. Mycologia **39**: 570–581. *tables 1–4.* S 1947.

Evans, Alexander W. The *Cladoniae* of Vermont. Bryologist **50**: 221–246. S [O] 1947.

Hagen, Asbjörn. Uredineae from East Greenland. Uredineana **2**: 62–68. 1946.

Latham, Roy. *Cetraria islandica* (L.) Asch. on Long Island, N. Y. Bryologist **50**: 269, 270. S [O] 1947.

Lepage, Abbe **Ernest.** Les lichens, les mousses et les hépatiques du Québec. Nat. Canad. **74**: 93–101. Mr–Ap [Je] 1947; 225–240. Jl–Au [S]; 280–292. S–O.

Long, W. H. Studies in the Gasteromycetes XV. Notes on new or rare species of *Tylostoma*. Lloydia **10**: 115–135. *pl. 1–7.* Je [S] 1947.

Mains, E. B. New and interesting species of *Cordyceps*. Mycologia **39**: 535–545. *f. 1–3.* S 1947.

Pollack, Flora G. Two additions to the Fungi Imperfecti. Mycologia **39**: 617–621. *f. 1.* S 1947.

Räsänen, Veli. Lichenes novi. I. Ann. Bot. Soc. Zool.-Bot. Vanamo **20**³: 1–34. 1944–45.

Rogers, Donald P. A new gymnocarpous heterobasidiomycete with gasteromycetous basidia. Mycologia **39**: 556–564. *f. 1.* S 1947.

Ruiz O., Manuel. Estudio de una neuva especie de levedura del género *Rhodotorula* Harrison aislada del néctar de las flores de *Martynia fragrans*. Anal. Inst. Biol. [Mexico] **18**: 25–41. *f. 1–8.* 1947.

Smith, Alexander H. North American species of *Mycena*. *i–xi*, 1–521. *pl. 1–98 + f. 1–56.* Ann Arbor. Univ. Mich. Press. 1947.

Smith, Alexander H. & Morse, Elizabeth E. The genus *Cantharellus* in the western United States. Mycologia **39**: 497–534. *f. 1–13.* S 1947.

Smith, Alexander H. & Walters, Maurice B. Notes on the genus *Armillaria*. Mycologia **39**: 622–625. *f. 1.* S 1947.

Thirumalachar, M. J. Species of the genera *Doassansia*, *Doassansiopsis* and *Buirillia* in India. Mycologia **39**: 602–611. *f. 1–9.* S 1947.

Waksman, Selman A. What is an antibiotic or an antibiotic substance? Mycologia **39**: 565–569. S 1947.

White, W. Lawrence & Downing, Mary H. The identity of "*Metarrhizium glutinosum*." Mycologia **39**: 546–555. *f. 1, 2 + table* 1. S 1947.

BRYOPHYTES

Andrews, A. LeRoy. Studies in the Warnstorf *Sphagnum* Herbarium. IV. The group *Acutifolia* in South America. Bryologist **50**: 181–186. Je [Jl] 1947.

Bartram, Edwin B. New species and new combinations of Guatemalan mosses. II. Bryologist **50**: 202–208. Je [Jl] 1947.

Bartram, Edwin B. Okinawa mosses. Bryologist **50**: 158–165. *f. a–h.* Je [Jl] 1947.

Clark, Lois & Svihla, Ruth Dowell. *Frullania involuta*. Bryologist **50**: 271–275. *f. 1–27.* S [O] 1947.

Conard, Henry S. *Braunia secunda* in Texas. Bryologist **50**: 270, 271. S [O] 1947.

Erskine, J. S. Minute mosses of Windsor, Nova Scotia. Bryologist **50**: 276–278. S [O] 1947.

Fulford, Margaret. *Leucolejeunea clypeata*—its habit and structure. Bryologist **50:** 97–112. *f. 1–38.* Je [Jl] 1947.

Fulford, Margaret, Carroll, Gladys & Cobbe, Thomas. The response of *Leucolejeunea clypeata* to variations in the nutrient solution. Bryologist **50:** 113–146. *pl. 1–11 + f. 1–9 + tables 1–3.* Je [Jl] 1947.

Fulford, Margaret & Kersten, Harold. The reaction of *Leucolejeunea clypeata* to variations in dosage of soft X rays. Bryologist **50:** 147–156. *pl. 12.* Je [Jl] 1947.

Haring, Inez M. A check-list of the mosses of the state of Arizona. Bryologist **50:** 189–201. Je [Jl] 1947.

Harvill, A. M. Notes on the moss flora of Alaska. I. The mosses of Attu Island collected by Margaret Bell Howard and George B. Van Schaack. Bryologist **50:** 169–177. Je [Jl] 1947.

Kucyniak, James. Two Pottiaceae new to Quebec: *Phascum cuspidatum* var. *americanum* and *Astomum phascoides.* Bryologist **50:** 178–180. Je [Jl] 1947.

Messmer, Louis W. & Frye, T. C. The *Polytrichum juniperinum* group between South America and the United States. Bryologist **50:** 259–268. *f. A, B.* S [O] 1947.

Persson, Herman. Further notes on Alaskan-Yukon bryophytes. Bryologist **50:** 279–310. *f. 1, 2.* S[O] 1947.

Phillips, Edwin Allen. Notes on Borabora, Society Islands, and a small collection of mosses from Mt. Temanu. Bryologist **50:** 166, 167. Je [Jl] 1947.

Phillips, Edwin Allen. A small collection of mosses from Nasake Jima, south of Hiroshima, Honshu, Japan. Bryologist **50:** 168. Je [Jl] 1947.

Phillips, Edwin Allen. Two species of moss collected on Southern Samar, Philippine Islands. Bryologist **50:** 167. Je [Jl] 1947.

S[teere], W. C. Bryological collecting during World War II. Bryologist **50:** 156, 157. Je [Jl] 1947.

Steere, William Campbell. A consideration of the concept of genus in the Musci. Bryologist **50:** 247–258. S [O] 1947.

Welch, Winona H. *Fontinalis duthicae* (Dixon mss.) Sim. Bryologist **50:** 187, 188. Je [Jl] 1947.

PTERIDOPHYTES

(See also under Spermatophytes: **Jones**)

Ching, R. C. On natural classification of the family "Polypodiaceae." Sunyatsenia **5:** 201–268. *chart.* 1940.

Ching, R. C. On the genus *Gleichenia* Smith. Sunyatsenia **5:** 269–288. 1940.

Chou, Ruth Chen-Ying. *Lygodium flexuosum* var. *accidens,* a new climbing fern from Kweichow Province, China. Bull. Torrey Club **74:** 374–377. *f. 1, 2* + A–E. S 1947.

Chou, Ruth Chen-Ying & Bartlett, H. H. *Lycopodium Copelandianum,* a Sumatran clubmoss. Bull. Torrey Club **74:** 369–373. *f. A, B′ + 1–4.* S 1947.

Chrysler, M. A. & Edwards, J. L. The ferns of New Jersey. *i–vii, 1–201. front., f. 1–110 + maps 1–76.* New Brunswick [N.J.] 20 O 1947.

Copeland, E. B. Comment on natural classification of the family Polypodiaceae by R. C. Ching. Sunyatsenia **6:** 159–177. 1941.

Degener, Otto *et al.* Flora Hawaiiensis: New Illustrated Flora of the Hawaiian Islands. [*Adiantum hispidulum, Cyrtomium caryotideum & Neottopteris nidus.*] 3 lamina. *illustr.* Honolulu. 15 N 1946.

Hazen, H. H. Survey of ferns in a Maine mountain area. Am. Fern Jour. **37:** 79–84. J–S [O] 1947.

Holttum, R. E. A revised classification of leptosporangiate ferns. Jour. Linn. Soc. **53:** 123–158. 21 O 1947.

Maxon, William R. New ferns from the northern Andes. Contr. Gray Herb. **165:** 69–75. *pl. 4–6.* 6 O 1947.

Maxon, William R. Puerto Rican fern notes. Proc. Biol. Soc. Wash. **60:** 123–130. 9 O 1947.

Neidorf, Charles. Studio fern photography. Am. Fern Jour. **37:** 67–77. *pl. 3, 4.* Jl–S [O] 1947.

Taylor, T. M. C. New species and combinations in *Woodsia* section *Perrinia.* Am. Fern Jour. **37:** 84–88. Jl–S 1947.

Tryon, Alice F. Glandular prothallia of *Notholaena Standleyi.* Am. Fern Jour. **37:** 88, 89. *f. 1.* Jl–S 1947.

Wagner, Warren Herbert. Tree-climbing Gleichenias. Am. Fern Jour. **37:** 90–95. *pl. 5.* Jl–S 1947.

Weatherby, C. A. *Polypodium lepidopteris* and its relatives in Brazil. Contr. Gray Herb. **165:** 76–82. 6 O 1947.

Wherry, Edgar T. Our easternmost *Cheilanthes* species. Am. Fern Jour. **37:** 77–79. Jl–S [O] 1947.

SPERMATOPHYTES

(See also under Ecology: **Holdridge** et al)

Acosta Solis, M. Cinchonas del Ecuador. 1–271. *pl. 1–41 + map.* Quito. My 1946.

Aguilar, José Luis. Corrección de la sinonimia de la planta llamada vulgarmente aguacate. Revista Soc. Cub. Bot. **3:** 152–154. N–D 1946.

Akers, John. New species [of Cacti] from Peru. Cactus & Succ. Jour. **19:** 162, 163. *f. 109, 110.* O 1947.

Anderson, J. P. Flora of Alaska, and adjacent parts of Canada. Part VI. Crassulaceae to Fabaceae. Iowa St. Coll. Jour. Sci. **21:** 363–423. *pl. 24–30.* Jl 1947.

Anderson, W. A. New distributional records in Kentucky. Castanea **12:** 50–56. Je [Au] 1947.

Arsène, Brother **Louis.** Plants new to the Flora of the Islands of Saint-Pierre et Miquelon. Rhodora **49:** 237–255. 11 O 1947.

Atchison, Earlene. Studies in the Leguminosae. 1. Chromosome numbers in *Erythrina* L. Am. Jour. Bot. **34:** 407–414. *f. 1–32 + table 1.* O 1947.

Babcock, Ernest Brown. The genus *Crepis*—Part I—The taxonomy, phylogeny, distribution, and evolution of *Crepis.* Univ. Calif. Publ. Bot. **21:** *i–x*, 1–198. *pl. 1 + f. 1–11 + & A–D + tables 1–12.* 30 Je 1947. Part 2—Systematic treatment. **22:** *i–x*, 199–1030. *pl. 2–36 + f. 12 + 305 + tables 13–19.* 27 Au.

Bacigalupi, Rimo. A new combination in the genus *Telesonix.* Leafl. West. Bot. **5:** 71. 31 O 1947.

Bailey, L. H. The Gouane palm of Haiti. Contr. Gray Herb. **165:** 5–9. *pl. 1, 2 + f. 1–3.* 6 O 1947.

Barneby, R. C. Distributional notes and minor novelties. Leafl. West. Bot. **5:** 61–66. 31 O 1947.

Bean, R. C. *et al.* Reports on the flora of Massachusetts—IV. Rhodora **49:** 257–277. N 1947.

Beetle, A. A. Distribution of the native grasses of California. Hilgardia **17:** 309–357. Ap 1947.

Beetle, Alan Ackerman. *Scirpus.* N. Am. Flora **18:** 481–504. 29 O 1947.

Breitung, A. J. Catalogue of the vascular plants of central eastern Saskatchewan. Canad. Field-Nat. **61:** 71–100. My 1947.

Brown, J. R. *Adromischus cristatus* (Haw.) Lam. Cactus & Succ. Jour. **19:** 92, 93. Je 1947.

Brown, William H. Useful plants of the Philippines. Volume 3. Repub. Philipp., Dept. Agr. & Comm. Tech. Bull. **10:** 1–507. *f. 1–170 + tables 1–80.* 1946.

Chin, T. C. & Youngken, H. W. The cytotaxonomy of *Rheum.* Am. Jour. Bot. **34:** 401–407. *f. 1–8 + table 1.* O 1947.

Cronquist, Arthur. *Chrysanthemum Balsamita* in Idaho. Leafl. West. Bot. **5:** 72. 31 O 1947.

Deam, Charles C., Yuncker, T. G. & Friesner, R. C. Indiana plant distribution records, VII. 1946. Proc. Ind. Acad. **56** (1947): 106–114. 1947.

Degener, Otto *et al.* Flora Hawaiiensis: New Illustrated Flora of the Hawaiian Islands. [Amaryllidaceae (desc. fam.), *Chamaesyce degeneri, Linaria canadensis* var. *texana, Arctium lappa* & *Cirsium lanceolatum.*] 5 lamina, *illustr.* Honolulu. 15 N 1946.

Dore, W. G. *Glyceria maxima* in Canada. Canad. Field-Nat. **61:** 174. S–O 1947.

Dutilly, Père **Artheme & Lapage,** Abbé **Ernest.** Coup d'oeil sur la flore subarctique du Québec, de la baie James au lac Mistassini [pars]. Nat. Canad. **74:** 66–78. Mr–Ap [Je] 1947. 207–224. Jl–Au [S]. 250–272. S–O [N].

Eastwood, Alice. Endemism in the flora of California. Contr. Gray Herb. **165:** 55–62. 6 O 1947.

Eastwood, Alice. Monoecious junipers in Modoc County, California. Leafl. West. Bot. **5:** 72. 31 O 1947.

Fassett, Norman C. *Veronica connata* Rafinesque. Jour. Wash. Acad. **37:** 353, 354. 15 O 1947.

Fernald, M. L. *Equisetum palustre,* example of careless bibliography and phytography. Rhodora 49: 278–286. N 1947.

Fogg, John M. Some methods applied to a state flora survey. Contr. Gray Herb. **165:** 121–132. *f. 1–4.* 6 O 1947.

Foster, Robert C. Studies in the Iridaceae, IV. Contr. Gray Herb. **165:** 106–111. 6 O 1947.

Gates, F. C. Kansas botanical notes, 1946, including species new to the state. Trans. Kan. Acad. **50:** 72–74. Je 1947.

Goodspeed T. H. On the evolution of the genus *Nicotiana.* Proc. Nat. Acad. **33:** 158–171. Je 1947.

Groh, Herbert. Hackberry in and adjacent to the Province of Quebec. Canad. Field-Nat. **61:** 141, 142. Jl–Au [S] 1947.

Habeeb, Herbert. *Vicia sepium* in New Brunswick. Rhodora **49:** 288. N 1947.

Hawkes, Alex D. The epiphytic orchids of Florida. Am. Orchid Soc. Bull. **16:** 564, 565. *2 f.* 1 O 1947.

Heiser, Charles. *Asperugo* in California. Leafl. West. Bot. **5:** 71. 31 O 1947.

Hernández Xolocotzi, E. La *Sheelea Liebmanii* Becc. (Coyol real o corozo); su distribución y producción. Anal. Inst. Biol. [Mexico] **18:** 43–70. *f. 1–11 + maps 1–3 + tables 1–7.* 1947.

Hoover, Robert F. A new name in the genus *Senecio* [*pattersonensis*]. Leafl. West. Bot. **5:** 60. 31 O 1947.

Howard, Richard A. The use of DDT in the preparation of botanical specimens. Rhodora **49:** 286–288. N 1947.

Howell, John Thomas. Additional notes on the grass family in Marin County, California. Leafl. West. Bot. **5**: 69–71. 31 O 1947.

Howell, J. T. *Euphorbia prostrata* Ait. in California. Leafl. West. Bot. **5**: 72. 31 O 1947.

Howell, John Thomas. Further studies of broadleaf *Erodium*. Leafl. West. Bot. **5**: 67, 68. 31 O 1947.

Hull, Edwin D. *Penstemon gracilis* in Indiana. Rhodora **49**: 256. 11 O 1947.

Hutchinson, J. B. Notes on the classification and distribution of genera related to *Gossypium*. New Phytol. **46**: 123–141. Je 1947.

Johnston, Ivan M. *Astragalus* in Argentina, Bolivia and Chile. Jour. Arnold Arb. **27**: 336–374. 15 Jl 1947; 375–409. 15 O.

Jones, Clyde H. Additions to the revised catalogue of Ohio vascular plants Ohio Jour. Sci. **47**: 201–205. 1947.

Jovet, P. Aux confins des Rubiacées et des Longaniacées. Not. Syst. [Paris] **10**: 39–53. *f. 1, 2.* N 1941

Keck, David D. A new *Penstemon* [*Paysoniorum*] from Wyoming. Leafl. West. Bot. **5**: 57, 58. 31 O 1947.

Kobuski, Clarence E. Studies in the Theaceae, XVI. Bibliographical notes on the genus *Laplacea*. Jour. Arnold Arb. **28**: 435–438. 15 O 1947.

Krukoff, B. A. & Moldenke, H. N. Supplementary notes on American Menispermaceae—IV. Bull. Torrey Club **74**: 378–382. S 1947.

Lasser, Tobias. El género *Leitgebia* Eichl. Bol. Acad. Ci. Fís. Mat. Nat. [Caracas] **9**: 245–248. *1 f.* 1946.

Lasser, T. Plantae novae venezuelanae [*Beilschmiedia Roheiana*]. Bol. Acad. Ci. Fís. Mat. [Caracas] **10**: 193–195. *1 f.* 1946.

Li, Hui-Lin. Notes on the Asiatic flora. Jour. Arnold Arb. **28**: 442–444. 15 O 1947.

Lindsay, G. E. Cacti from San Pedro Nolasco Island. Des. Pl. Life **19**: 71–76. My 1947.

Lindsay, George. New cactus species from San Pedro Nolasco Island. Cactus & Succ. Jour. **19**: 151–154. *f. 99–103.* O 1047.

Lloyd, F. E. & Taylor, G. Some new species of *Utricularia*. Contr. Gray Herb. **165**: 82–90. *f. 1–5.* 6 0 1947.

Louis-Marie, Père. La taxonomie doit-elle s'expérimentaliser? Contr. Gray Herb. **165**: 112–131. 6 O 1947.

McClure, F. A. The genus *Bambusa* and some of its first-known species. Blumea Suppl. **3**: 90–112. *pl. 1–7.* 16 O 1946.

MacDaniels, L. H. A study of the Fe'i banana [*Musa Troglodytarum*] and its distribution with reference to Polynesian migrations. Bishop Mus. Bull. **190**: 1–56. *pl. 1–10* + *f. 1–5.* 1 My 1947.

Martínez, Maximino. Los *Cupressus* de Mexico. Anal. Inst. Biol. [Mexico] **18**: 71–149. *f. 1–48.* 1947.

Merrill, E. D. The technical name of allspice. Contr. Gray Herb. **165**: 30–38. *f. 1.* 6 O 1947.

Merrill, E. D. & Sandwith, N. Y. On the identity of the genera *Cupulissa* Raf. and *Platolaria* Raf. Jour. Arnold Arb. **28**: 430–434. 15 O 1947.

Neal, Marie C. A *Manilkara* found on Oahu, Hawaii. Pacif. Sci. **1**: 243, 244. *1 f.* O 1947.

Ogden, E. C. *Potamogeton tennesseensis* new to the [Gray] Manual range. Rhodora **49**: 255, 256. 11 O 1947.

Palmer, Ernest J. Second supplement to the spontaneous flora of the Arnold Arboretum. Jour. Arnold Arb. **28**: 410–418. 15 O 1947.

Parodi, Lorenzo R. The Andean species of the genus *Stipa* allied to *Stipa obtusa.* Blumea Suppl. **3**: 63–70. *f. 1.* 16 O 1946.

Peck, Morton E. Certain Oregon saxifrages. Leafl. West. Bot. **5**: 58–60. 31 O 1947.

Pérez Moreau, Román A. Reseña botánica sobre los parques nacionales Nahuel Haupi, Los Alerces y Lanín. Anal. Mus. Patag. **1**(1945): 253–276. *pl. 1–43.* 1946.

Pichon, M. Le genre *Combretodendron* et les Lécythidacées. Not. Syst. [Paris] **12**: 192–197. F 1946.

Pichon, M. Sur les Alismatacées et les Butomacées [includes *Albidella,* gen. nov.,—Cuba, Br. Hond.; key to gen. of redefined Alismaceae]. Not. Syst. [Paris] **12**: 170–183. F 1946.

Pichon, M. Sur les Commélinacées [Keys to tribes and genera; also 3 new genera in Western Hemisphere]. Not. Syst. [Paris] **12**: 217–242. F 1946.

Polunin, Nicholas. Additions to the flora of Southampton and Mansel Islands, Hudson Bay. Contr. Gray Herb. **165**: 94–105. 6 O 1947.

Ponce de León, Antonio. Joyas de la flora cubana. El copey (*Clusia rosea* Jacq.). Revista Soc. Cub. Bot. **3**: 143. *1 pl.* N–D 1946

Quisumbing, Eduardo. Studies on *Phalaenopsis,* III. Philipp. Jour. Sci. **77**: 1–18. *pl. 1–5.* My 1947.

Rehder, Alfred. Notes on some cultivated trees and shrubs, VI. Jour. Arnold Arb. **28**: 445, 446. 15 O 1947.

Rehder, Alfred. Two new forms of *Rhododendron roseum.* Contr. Gray. Herb. **165**: 9-11. 6 O 1947.

Roland-Gosselin, R. Are the species of *Rhipsalis* discovered in Africa indigenous? Des. Pl. Life **19**: 121-123, 124. O 1947.

Rollins, Reed C. Generic revisions in the Cruciferae: *Sibara.* Contr. Gray Herb. **165**: 133–143. 6 O 1947.

St. John, Harold. *Pleomele Fernaldii* (Liliaceae), a new species from the Hawaiian Islands. Hawaiian plant studies 16. Contr. Gray Herb. **165**: 39–42. *pl. 3.* 6 O 1947.

Sandwith, N. Y. Two new leguminous trees of British Guiana. Contr. Gray Herb. **165**: 25–29. 6 O 1947.

Schnee, L. *Stenoptera Rohlii;* una especie nueva de las Orquideas. Bol. Acad. Ci Fís. Mat. Nat. [Caracas] **9**: 249–252. *2 f.* 1946.

Schweinfurth, Charles. A new *Pachyphyllum* from Peru. Am. Orchid Soc. Bull. **16**: 564, 565. *f. 1–4.* 1 O 1947

Schweinfurth, Charles. A novel *Dichaea* from Peru. Am. Orchid Soc. Bull. **16**: 614, 615. *f. 1–7.* 1 N 1947.

Shanks, R. E. & Sharp, A. J. Summer keys to the trees of eastern Tennessee. Jour. Tenn. Acad. **22**: 114–133. Ap 1947.

Smith, Lyman B. & Schubert, Bernice G. Some Mexican begonias. Contr. Gray Herb. **165**: 90–94. *f. 1.* 6 O 1947.

Standley, Paul C. & Steyermark, Julian A. Studies of Central American plants—VII. Publ. Field Mus. Nat. Hist. Bot. **23**: 195–265. *pl. 5.* 22 O 1947.

Stearn, William T. The nomenclature and synonymy of *Tofieldia calyculata* and *T. pusilla.* Jour. Linn. Soc. **53**: 194–204. *f. 1–33.* 21 O 1947.

Stebbins, G. Ledyard. The origin of the complex of *Bromus carinatus* and its phytogeographic implications. Contr. Gray Herb. **165**: 42–55. *f. 1.* 6 O 1947.

Steenis, C. G. J. van. Notes on a number of New Guinean species. Jour. Arnold Arb. **28:** 419–423. 15 O 1947.

Svenson, Henry Knute. Scirpeae. N. Am. Flora **18:** 479. 29 O 1947.

Turner, George H. Alpine plants in the Pigeon Lake district of Alberta. Canad. Field-Nat. **61:** 126. Jl–Au [S] 1947.

Uitewaal, A. J. A. *Haworthia guttata* Uitewaal spec. nov. Des. Pl. Life **19:** 101. *illust.* 12 S 1947.

Uitewaal, A. J. A. Some little known Haworthias, *Haworthia fouchei* Poelln. Des. Pl. Life **19:** 53. Ap 1947. *Haworthia truncata* forma *crassa* Poelln. 78, 79. My.

White, Stephen S. New plants from northeastern Sonora, Mexico, and notes on extensions of range. Jour. Arnold Arb. **28:** 439–441. 15 O 1947.

ECOLOGY AND PLANT GEOGRAPHY

Dexter, Ralph W. The marine communities of a tidal inlet at Cape Ann, Massachusetts: A study in bio-ecology. Ecol. Monogr. **17:** *261–294. f. 1–17 + table 1–11.* Jl [O] 1947.

Dirks-Edmunds, Jane C. A comparison of biotic communities of the cedar-hemlock and oak-hickory associations. Ecol. Monogr. **17:** 235–260. *f. 1–10 + tables 1, 2.* Jl [O] 1947.

Farmer, C. M. Ecological factors in the Pike County pocosin. Jour. Ala. Acad. **18:** 57. D 1946.

Holdridge, L. R. *et al.* The forests of western and central Ecuador. 1–134. *85 photos + 2 maps.* U. S. Dept. Agr. Forest Service. Je 1947 [Offset].

Johnson, Frederick & Raup, Hugh M. Grassy Island: Archaeological and botanical investigations of an Indian site in the Taunton River, Massachusetts. Pap. Peabody Found. Arch. **1:** *i–viii,* 1–68. *pl. 1–3 + f. 1–9.* 1947.

Sharp, Aaron J. Informe preliminar sobre algunos estudios fitogeográficos efectuados en México y Guatemala. Revista Soc. Mex. Hist. Nat. **7:** 35–39. *f. 1–5.* D 1946.

Woodson, Robert E. Notes on the "historical factor" in plant geography. Contr. Gray Herb. **165:** 12–25. *f. 1, 2.* 6 O 1947.

PHYTOPATHOLOGY

(See also under Fungi: **Dolan**)

Foster, H. H. The control of cabbage downy mildew through the use of sprays. Phytopathology **37:** 712–720. *tables 1–4.* O 1947.

Gruenhagen, R. H., Riker, A. J. & Richards, C. Audrey. Burn blight of jack and red pine following spittle insect attack. Phytopathology **37:** 757–772. *f. 1–4 + tables 1–3.* O 1947.

Henry, B. W. & Riker, A. J. Wound infection of oak trees with *Chalara quercina* and its distribution within the host. Phytopathology **37:** 735–743. *f. 1 + tables 1–3.* O 1947.

Leach, L. D. Growth rates of host and pathogens as factors determining the severity of preemergence damping-off. Jour. Agr. Res. **75:** 161–179. *f. 1–6.* 15 S 1947.

Marchionatto, Juan B. Nota sobre *Balansia claviceps,* hongo parásito de las gramíneas. Revista Argent. Agron. **14:** 175, 176. *1 f.* Je 1947.

Rodenhiser, H. A. & Hurd-Karrer, Annie M. Evidence of fusion bodies from urediospore germ tubes of cereal rusts on nutrient-solution agar. Phytopathology **37:** 744–756. *f. 1–5 + table 1.* O 1947.

Sprague, Roderick. Septoria disease of Gramineae in western United States. Oregon St. Monogr. Stud. Bot. **6**: 1–151. *f. 1–18.* D 1944.

Stark, Frank L., & Lear, Bert. Miscellaneous greenhouse tests with various soil fumigants for the control of fungi and nematodes. Phytopathology **37**: 698–711. O 1947.

Thirumalachar, M. J. & Dickson, James G. Chlamydospore germination and artificial culture of *Ustilago striiformis* from timothy and bluegrass. Phytopathology **37**: 730–734. *f. 1, 2.* O 1947.

Weimer, J. L. Resistance of *Lathyrus* spp. and *Pisum* spp. to *Ascochyta pinodella* and *Mycosphaerella pinodes.* Jour. Agr. Res. **75**: 181–190. *f. 1–3.* 15 S 1947.

Wilson, E. E. The branch wilt of Persian walnut trees and its cause. Hilgardia **17**: 413–436. *pl. 1–4* + *f. 1–4 tables 1, 2.* Au 1947.

Wolf, Frederick A. Tobacco downy mildew, endemic to Texas and Mexico. Phytopathology **37**: 721–729. *f. 1, 2.* O 1947.

MORPHOLOGY

(including anatomy and cytology in part)

(See also under Spermatophytes: **Atchison**)

Artschwager, Ernst. Pollen degeneration in male-sterile sugar beets with special reference to the tapetal plasmodium. Jour. Agr. Res. **75**: 191–197. *pl. 1–7.* O 1947.

Barton, Lela & Thornton, Norwood C. Germination and sex population studies of *Ilex opaca* Ait. Contr. Boyce Thompson Inst. **14**: 405–410. *tables 1–3.* Jl–S [N] 1947.

Boke, Norman H. Development of the adult shoot apex and floral initiation in *Vinca rosea L.* Am. Jour. Bot. **34**: 433–439. *f. 1–12.* O 1947.

Buchholz, J. T. Methods in the preparation of chromosomes and other parts of cells for examination with an electron microscope. Am. Jour. Bot. **34**: 445–454. *f. 1–22.* O 1947.

Garber, E. D. The pachytene chromosome of *Sorghum nitrans.* Jour. Hered. **38**: 251, 252. *f. 5.* Au [O] 1947.

Gosselin, L. A. Étude sur les noyaux interphasiques et quiescents. II. Revue d'Oka **21**: 70–87. Mr–Ap 1947.

Joshi, A. C. Floral histogenesis and carpel morphology. Jour. Indian Bot. Soc. **26**: 63–74. F 1947.

King, Gladys S. Peripheral deposits of citrus fruit vesicles stained by oil-soluble dyes. Am. Jour. Bot. **34**: 427–431. *f. 1–3.* O 1947.

Nielsen, Etlar L. Macrosporogenesis and fertilization in *Bromus inermis.* Am. Jour. Bot. **34**: 431–433. *f. 1–7.* O 1947.

Rick, C. M. Partial suppression of hair development indirectly affecting fruitfulness and the proportion of cross-pollination in a tomato mutant. Am. Nat. **81**: 185–202. My 1947.

Schnee, L. Ramifications in *Alsophila caracasana.* Bol. Acad. Ci. Fis. Mat. Nat. [Caracas] **10**: 197–210. *f. 1–25.* 1946.

Sharman B. C. The biology and developmental morphology of the shoot apex in the Gramineae. New Phytol. **46**: 20–34. *pl. 1–4.* Je 1947.

Smith, Frank H. Floral anatomy of the Santalaceae and some related forms. Oregon St. Monogr. Stud. Bot. **5**: 1–93. *pl. 1–15.* S 1942

Snow, Mary & Snow R. On the determination of leaves. New Phytol. **46:** 5–19. *f. 1–10* Je 1947.

GENETICS
(including cytogenetics)

Karper, R. E. & Quinby, K. R. The inheritance of callus formation and seed shedding in *Sorghum*. Jour. Hered. **38:** 211–214. *f. 5, 6.* Jl [S] 1947.

Langham, D. G. Genetics of *Sesame* IV. Some genetic variations in the color of the sesame flower. Jour. Hered. **38:** 211–224. *f. 9, 10.* Jl [S] 1947.

Lesley, J. W. & Lesley, Margaret Mann. Flesh color in hybrids of tomato. Jour. Hered. **38:** 245–251. *tables 1–3.* Au [O] 1947.

Mehlquist, G. A. L. A genetic and cytological study of certain orchidaceous genera with particular reference to those in which appreciable breeding work has already been done. Am. Orchid Soc. Bull. **16:** 330–333. 6 Je 1947.

White, O. E. & Bowden, W. M. Oriental and American bittersweet hybrids. Jour. Hered. **38:** 125–127. *f. 11.* Ap 1947.

PLANT PHYSIOLOGY
(See also under Taxonomy: Bryophytes: **Fulford, Carroll & Cobbe; Fulford & Kersten**)

Benson, A. & Calvin, M. The dark reductions of photosynthesis. Science **105:** 648, 649. 20 Je 1947.

Borthwick, H. A. Day length and flowering. Yearb. U. S. Dept. Agr. **1943–1947:** 273–283. 1947.

Dorland, Robert E. & Went, F. W. Plant growth under controlled conditions. VIII. Growth and fruiting of the Chili pepper *(Capsicum annuum).* Am. Jour. Bot. **34:** 393–401. *f. 1–13 + tables 1–4.* O 1947.

Dustin, J. Supplement [to colchicine bibliography]. Lloydia **10:** 106–114. Je [S] 1947.

Eigsti, O. J. Colchicine bibliography. Lloydia **10:** 65–105. Je [S] 1947.

Gray, W. D. & Martin, G. W. The growth of fungi on asphalt-treated paper. Mycologia **39:** 587–601. *f. 1–7 + tables 1–6.* S 1947.

Hildebrandt, Albert C. & Riker, A. J. Influence of some growth-regulating substances on sunflower and tobacco tissue in vitro. Am. Jour. Bot. **34:** 421–427. *f. 1–12 + table 1.* O 1947.

Jacobson, Louis & Overstreet, Roy. A study of the mechanism of ion absorption by plant roots using radioactive elements. Am. Jour. Bot. **34:** 415–420. *f. 1–3 + table 1.* O 1947.

Kavanagh, Frederick. Antiluminescent activity of antibacterial substances. Bull. Torrey Club **74:** 414–425. *tables 1–3.* S 1947.

Robbins, W. J., Kavanagh, F. & Hervey, A. Antibiotic substances from Basidiomycetes. I–II. Proc. Nat. Acad. **33:** 171–182. Je 1947.

Roca, Juan. Actividad proteolítica de *Euphorbia prostrata* Ait., y *Eurphorbia peplus,* L. Anal. Inst. Biol. [Mexico] **28:** 7–14. *f. 8.* 1947.

Sparrow, A. H. & Hammond, Marian R. Cytological evidence for the transfer of desoxyribose nucleic acid from nucleus to cytoplasm in certain plant cells. Am. Jour. Bot. **34:** 439–445. *f. 1–12 + table 1.* O 1947.

Steinberg, Robert A. Growth responses of tobacco seedlings in aseptic culture to diffusates of some common soil bacteria. Jour. Agr. Res. **75:** 199–206. *f. 1–4 + tables 1, 2.* O 1947.

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SOME CUTINIZED SEED MEMBRANES FROM THE COAL-BEARING ROCKS OF MICHIGAN

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Because of the resistance of cutin to decay, plant tissues protected by this substance are often preserved even though all others have completely disappeared. Spore exines and fragments of leaf epidermis are the cutinized parts most commonly found in coal and plantbearing shales, but occasionally seed cuticles of the type described in this paper are found. In many ancient and a few modern seeds cuticles are present on some of the tissues of the interior. In one seed group, the Trigonocarpales, a cuticle covers the inner surface of the integument and the outer surface of the nucellus, and in other seeds there are cutinized or suberized tissues around the embryo sac. Frequently the cutinized spore coat immediately enclosing the embryo sac is visible in fossil seeds. In the seeds described in this paper almost all of the tissues have disappeared except the highly resistant cutinized internal cell layers, and the cuticles were pressed together as membranaceous films between the rock layers. These cuticles were freed by dissolving the rock, and many were removed intact. When first isolated they appeared as dark brown or black objects, but treatment with appropriate chemicals rendered them sufficiently transparent for microscopic examination. The original size of these seeds can be only estimated because in most of them all of the integument except the inner epidermis had decayed. Regardless, however, of the paucity of tissue preservation, some of these fossils show characters by means of which they can be classified.

Localities. The material described in this paper came from three coal mines in southern Michigan. Two of them are in Saginaw County near St. Charles. One of these, the Big Chief No. 8 mine, is within one-half mile of the northern limits of the town, and the other, the St. Charles-Garfield mine, is at Eastwood, three miles north of St. Charles. Both of these mines have been abandoned although they were in operation between 1929 and 1940 when the material was collected.

The third locality is the Woodville mine near the northeastern corner of the present city limits of Jackson. Its exact location is unknown because it was abandoned many years ago, and since then the shaft has been filled and the dump leveled. The fossiliferous rock from this mine is a piece of dark carbonaceous shale collected and labeled by Alexander Winchell, and placed in the museum of the University of Michigan many years ago. The date of collection is not on record but it may have been previous to 1860. The label

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bears Winchell's collection number 6526, and gives the depth as 97½ feet below the surface. On the label is the notation: "Vegetable tissue having minute cellular structure resembling modern Jungermanniales." It was this notation that prompted examination of the specimen. The vegetable tissue that Winchell noted, however, is the fragments of a small form of *Sphenopteris* (fig. 17) related to *S. obtusiloba*.

Age of the Material. All the coalbearing rocks in Michigan belong to the Saginaw group which is believed to be equivalent to the late Pottsville of the lower Pennsylvanian. At St. Charles the coals are at, or approximately at, the Saginaw coal horizon which is the oldest of the commercially valuable coals of the state. The position of the coal in the Woodville mine is uncertain, but the coals formerly mined in the vicinity of Jackson were generally assigned to the Verne horizon, which is higher than the Saginaw coal. However, practically no diagnostic fossils, either plant or animal, have been identified from any of the now abandoned mines at Jackson, and the position of the coal in the Woodville mine is entirely a matter of inference based upon evidence that is not conclusive. The numerous *Stigmariae* and stem casts formerly collected there in large quantities are all long-ranging forms that occur in abundance throughout the entire sequence of the Pennsylvanian system. However, the fact should not be overlooked that the seed cuticles from the two localities in Saginaw County, and presumably from the Saginaw coal horizon, are similar both in form and in manner of preservation to those from the Woodville mine, a similarity which indicates like environments of deposition if not contemporaneity. Also, the fact should be mentioned that the small *Sphenopteris* from the Woodville mine is of a type not yet found in Michigan as high as the Verne, although it is often abundant in the shales immediately above the Saginaw coal.

Technique. The plant cuticles were separated from the shale fragments by soaking them in dilute nitric acid for several days, followed by similar treatment in dilute caustic soda solution. The acid treatment is not essential because the shales disintegrate in pure water, but the process goes on faster and more thoroughly in acid and alkali. After the shale had broken down, the plant fragments were separated from the sludge with a fine sieve. They were then handled individually and macerated in Schulze's reagent. This was followed by treatment with dilute (about 1%) ammonium hydroxide. When more highly concentrated ammonium hydroxide was used, the cuticles tended to dissolve, especially after the Schulze's reagent had been allowed to act long enough to render the cuticles sufficiently transparent for microscopic examination. Prolonged soaking in Schulze's reagent always resulted in complete disintegration of the cuticles regardless of the subsequent treatment. The fragments were mounted in Diaphane directly from 95% alcohol.

Nomenclature of Fossil Seeds. Because of the detached condition of fossil seeds, it is often necessary to classify them separately from other plant parts. Seeds belonging to the same species may appear quite different if preserved in different ways. They are often preserved only as flattened compressions showing surface features but no internal structure. The symmetry is also distorted by the flattening. Many ancient seeds were provided with soft fleshy external coats which commonly decayed, leaving exposed on the surface of the fossil the more or less ribbed or lined stony subsurface layer. Thus the partially preserved seed may present an appearance quite different from the original. It is usually necessary to apply separate generic names to seeds preserved in different ways even at the risk of having more than one name for the same kind of seed. Although awkward in some respects, multiplicity of names helps to avoid much of the confusion that would otherwise ensue.

The system of seed nomenclature in most general use for Paleozoic seeds was proposed by Seward (5) who designated three groups, the Lagenostomales, the Trigonocarpales, and the Cardiocarpales. These categories for the most part embrace seeds belonging to the Lyginopteridaceae, the Medullosaceae, and the Cordaitae respectively. These "seed orders" accommodate the majority of seeds preserved as petrifactions or three-dimensional casts, but they are not always appropriate for compressions in which the natural symmetry has become altered. Also, some seeds with tissues preserved do not fit into any of these groups.

None of the seeds described in this paper can be identified with species already known, but one of them, because of the shape of the embryo sac and pollen chamber, can be referred to the genus *Physostoma* of the Lagenostomales. Another seed shows characteristics of the Trigonocarpales, but it cannot in the absence of certain essential features be assigned to any previously described genus. The author has placed it in a new genus, *Trigonocarpolithus.* Other seeds of more uncertain position are placed in the form-genus *Spermatites.* As stated, all these seeds are believed to belong to pteridosperms.

Rather little work has been done on seed cuticles, although spores associated with them have received the attention of a number of specialists. Among the few contributions on the subject of seed cuticles is one by Miner (3), who described several forms from the late Cretaceous of Western Greenland, and another by Harris (1), who named four genera from the Rhaetic of East Greenland. The seeds described by Harris, which are unattached and of questionable affinities, are believed to belong for the most part to cycadophytes and other gymnosperms. The distinguishing characters used by Harris are the thickness of the cutinized integument and nucellus, the extent of cutinization of the nucellus, the length of the micropylar canal, and

the presence or absence of a megaspore membrane. Since the Michigan seeds are not closely related to the Greenland forms, these characters are not applicable to them, although the type of preservation and the problems of interpretation are similar for both.

One of the significant features of the present study is the revelation of results that can be obained by use of maceration techniques in the study of

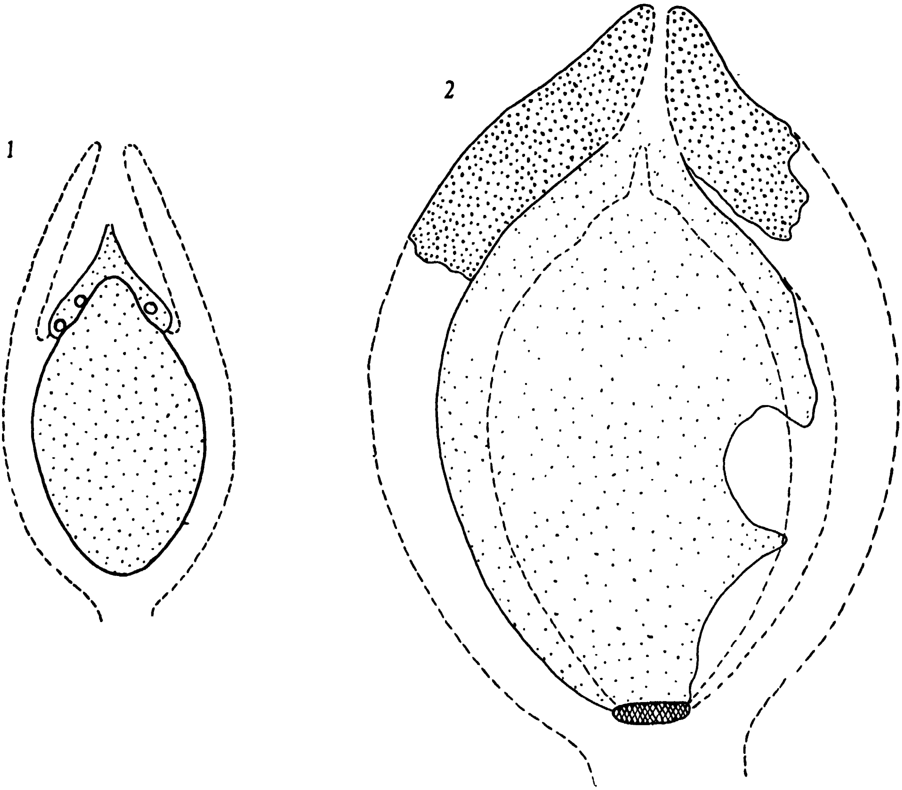


FIG. 1. *Physostoma Winchellii* sp. nov. Restoration of seed. The embryo sac and pollen chamber are outlined in solid lines and stippled. The assumed extent of the integument is shown by dashed lines. × 17. FIG. 2. *Trigonocarpolithus typicus* gen. et sp. nov. Restoration of seed. Restored portions are shown by dashed lines, and the preserved parts are bounded by solid lines and stippled. In the specimen from which this sketch was made, the nucellus is not visible, but its approximate position is indicated. × 17.

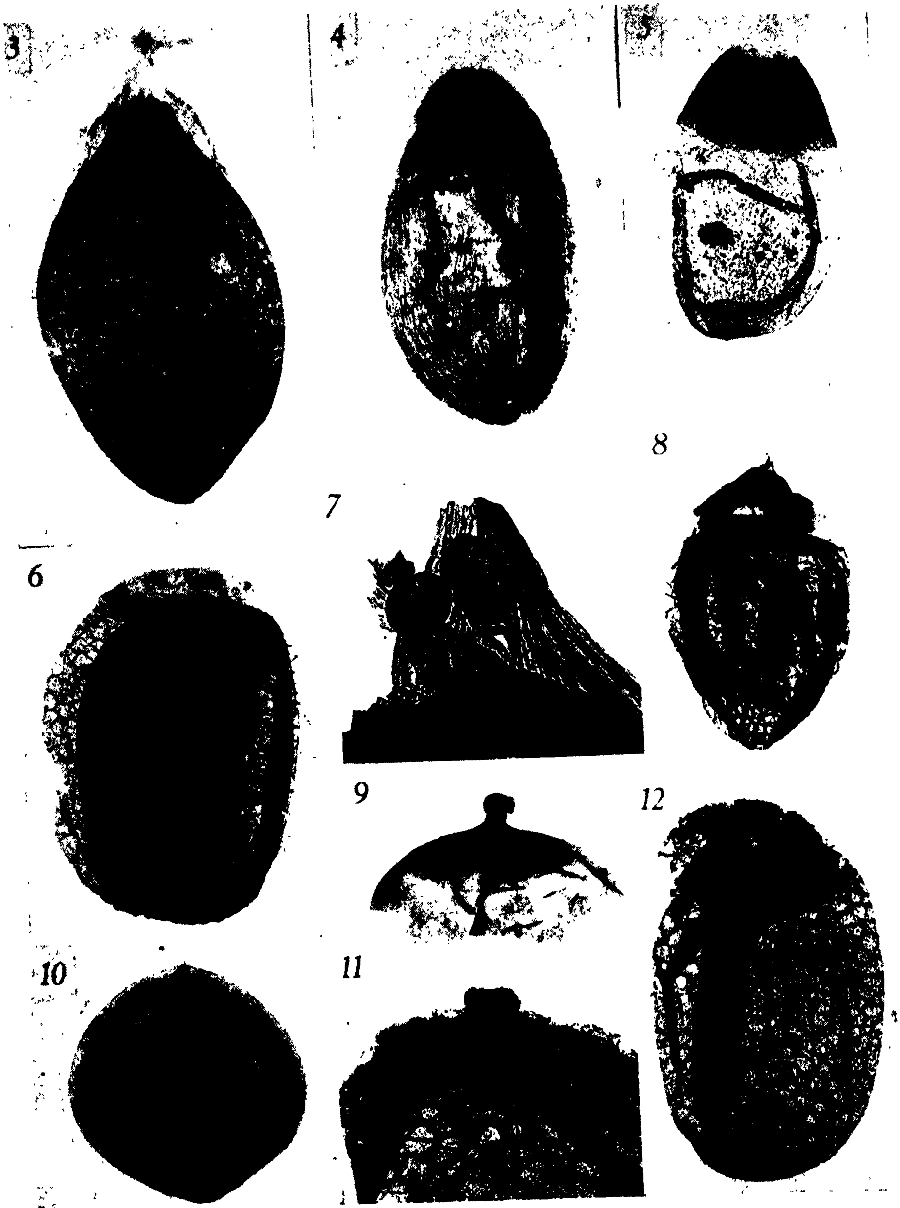
ancient vegetation. Not only are the techniques simple in themselves, but they are applicable to material that is available in large quantities, and more extended use of them would produce unexpected results.

LAGENOSTOMALES. In this group of Paleozoic seeds the integument is fused with the nucellus except in the region of the pollen chamber (as in modern cycads), and the vascular supply is restricted to the integument.

Members of the group are typically small, only a few millimeters in length, and in all known instances were borne in cupules. The group is typified by *Lagenostoma Lomaxi*, the seed of *Lyginopteris oldhamia*, but it also contains *Physostoma*, a seed first described by Williamson from the British Coal Measures, and elaborated upon by Oliver (4).

Physostoma Winchellii Arnold, sp. nov. (figs. 1, 3–5, 7). This name is proposed for a small seed found in considerable numbers at the Woodville and Big Chief No. 8 mines. The cutinized parts are small oval bodies ranging from 950 to 1450 microns in width, and 1600 to 2650 microns in length. Some, possibly immature ones, are smaller, and occasional ones are slightly larger, but the majority fall within the limits of these measurements. The bodies are broadest at the middle and rounded at both ends, but the apical end is slightly narrowed where a conical cap fits over it, formed from epidermis of the tissue enclosing the pollen chamber. This cap is about 1 mm. broad at the base in an average specimen, and a little more than 1 mm. high (fig. 3). In most specimens the tip of the cap is broken off (figs. 4, 5). The cap is made of slender, thick-walled cells that extend lengthwise and converge toward the ostiole. Although the dimensions vary considerably, these cells are roughly 20 μ broad with wall layers about 8 μ thick separating adjacent cell cavities. The length of these cells is difficult to determine because of the slightly tortuous course they follow. At the base of the cap is a border about 3 cells wide, in which the cells are shorter than the others.

The egg-shaped cuticular bodies described in the preceding paragraph represent the inner layer of tissue immediately surrounding the large internal object which Oliver (4), in his description of *Physostoma elegans*, calls the "embryo sac." Although no embryo has been found within this sac, the term nevertheless is appropriate because it is here that the embryo would have formed whenever that stage in ovule development would have been reached. The sac is really a female gametophyte enclosed by the stretched and distended wall of the spore from which it originated. This spore is commonly called a "megaspore," but this apparently is not the proper designation for it in view of the observations of Thomson (6) on the relative sizes in seed plants of the spores that give rise to the pollen and female gametophytes. Thomson has found that in seed plants, the spore that is commonly called the megaspore is not consistently larger than the so-called microspore, and in many plants is actually the smaller of the two. Furthermore, he found that the application of the names "microspore" and "megaspore" to seed plants is based upon a misinterpretation of Hofmeister's work in which the cell from which the embryo sac develops is simply referred to as a "spore." In *P. elegans* the "embryo sac" with its enclosing cutinized membrane is surrounded by a tapetum which shows in thin sections of petrifactions as a black, more or less structureless layer about 100 microns thick.



FIGS. 3–5. *Physostoma Winchellii* sp. nov. ×22. FIG. 6. *Spermatites reticulatus* sp. nov. Specimen containing a large thin-walled spore. ×30. FIG. 7. *Physostoma Winchellii* sp. nov. Portion of apex of embryo sac showing pollen grains in the pollen chamber. ×100. FIG. 8. *Spermatites reticulatus* sp. nov. Specimen with conical cap in place. ×26. FIG. 9. *Spermatites cylix* sp. nov. ×6.5. FIG. 10. *Spermatites globosus* sp. nov. ×9.5. FIG. 11. *Spermatites reticulatus* sp. nov. Apical portion with conical cap removed showing the short papilla. ×38. FIG. 12. *Spermatites reticulatus* sp. nov. ×30.

The tapetum in turn is surrounded by a layer of delicate secretory cells. The outer part of the nucellus is joined to the inner surface of the integument except for the free portion at the apex which is crowned by the pollen chamber. The pollen chamber in *Physostoma* is distinctive in that the upwardly arched apical part of the "embryo sac" indents the bottom of the pollen chamber like the incurved bottom of a wine bottle. Although in our material nothing is preserved except the tapetal layer surrounding the "embryo sac" cavity, and the apical cap which encloses the pollen chamber, the whole structure is sufficiently like that part of *Physostoma elegans* to render identity with that genus a matter of practical certainty. The other characteristic of *Physostoma*, the splitting of the integument into free tentacles where it overarches the pollen chamber, is not visible in our specimens.

The tapetum surrounding the "embryo sac" and the tissue enclosing the pollen chamber are the most decay-resistant structures in *Physostoma,* and as a result are preserved after other parts of the seed have disappeared. No traces of the original spore membrane can be detected. Oliver states that the spore in *P. elegans* has a very thin membrane which is difficult to detect. The tapetum in the ovule in seed plants in general is believed to be derived from sporogenous tissue, which could be the explanation of its cutinized or suberized condition.

In the material under consideration, the tapetum surrounding the central cavity is evidently cellular. Originally the cells were dark, but under the influence of Schulze's reagent they bleach to a reddish brown. Oliver describes the tapetum as a black structureless layer which has been compressed by the growing gametophyte and infiltrated with dark substances secreted by the adjacent external layers. In a few specimens something can be ascertained concerning its cellular composition, but nowhere is the structure well preserved. In specimens of *Physostoma Winchellii* that have been subjected to rather prolonged treatment with Schulze's reagent, the cell outlines are dimly revealed. They appear to be thin-walled, four- to seven-sided, and mostly longer than broad. It is difficult to measure these cells accurately, but they average about 45 μ in breadth.

In some of the specimens the tapetal jacket is surrounded by a thin layer of long, slender, lengthwise-extending cells very similar in shape to those composing the jacket of the pollen chamber. This tissue appears to be two or more cells deep, and the cell walls are thin and light brown. This apparently is part of the nucellus although its exact identity is uncertain. It seems to lie adjacent to the tapetal layer but is not firmly attached to it. It is possible that originally there was an intervening secretory layer which has disappeared, leaving the two layers in contact but not organically connected.

Oliver comments upon the abundance of pollen grains in the pollen chamber of *Physostoma elegans*. In one section 30 grains were counted, and 17 in another. Broadly oval pollen grains are fairly abundant in some of our specimens but the most to be found anywhere is thirteen. These grains measure 81 by 94 μ (fig. 7). Their structure is not clearly discernible because they can be seen only through the layer of cutin that surrounds the pollen chamber, but each one appears to contain a central cell enclosed by a jacket of nearly transparent cells. Their dimensions are nearly twice those of the pollen grains attributed to the British species.

The foregoing description is based upon more than a dozen specimens, some of which reveal the structure better than others. Their generic identity with *Physostoma* is obvious even though the genus was originally based upon material preserved in coal balls and in which all the tissues were more or less intact. In our specimens the peculiar integument has completely disappeared, and the only remaining parts are the tissues enclosing the "embryo sac" cavity and the pollen chamber. The distinguishing features are the shape of the embryo sac and the pollen chamber, and the fact that similar pollen grains are present in considerable numbers.

Although these seed cuticles show obvious relationships with *Physostoma elegans*, they display sufficient differences to require a separate specific name. The original complete seed was certainly smaller than *P. elegans* in which the "embryo sac" is nearly 5 mm. long. In our seed this body is only about one half as long but in proportion is slightly broader. Judging from the size of the preserved part, *P. Winchellii* was probably about 4 mm. long and from 2 to 2.5 or possibly 3 mm. in width. In addition to an apparent difference in size and shape, the pollen chamber in our species is a trifle more massive and more acutely conical. A pronounced difference in the size of the pollen has already been mentioned.

TRIGONOCARPALES. This group of Paleozoic seeds, believed to belong for the most part to the Medullosaceae, possesses several distinctive features which enable its members to be recognized even when very imperfectly preserved. The main body of the seed possesses radial symmetry. Except for its basal attachment, the nucellus is free from the integument, and the apex of the nucellus contains the pollen chamber which is surmounted by a hollow slender beak through which the pollen passes on its way to the pollen chamber. This beak, at pollination time, fitted more or less directly into the micropyle. The inner surface of the integument is covered with a fairly thick cuticle, and the epidermis of the adjacent nucellus is similarly reinformed. There thus exist in these seeds two protective layers which under proper conditions of preservation retain the outlines of the integument cavity and the form of the nucellus.

Trigonocarpolithus Arnold, gen. nov. This generic name is proposed for seed cuticles which, because of the presence of separate layers representing the lining of the integumentary cavity and the covering of the nucellus, show evidence of affinity with the Trigonocarpales, but which owing to the disappearance of essential diagnostic features in the integument, cannot be assigned to any previously described genus. Fully aware of the multiplicity of names already in existence for fossil seeds, and cognizant of the fact that many of these names exist only because of the different ways seeds are preserved, the author proposes another one only after considerable deliberation and with the full conviction that it is necessary. Regardless of the superabundance of generic names for fossil seeds, occasions still arise when more are needed, and in this particular instance the only other possible course would be to resort to the designation "*Carpolithus*" which simply means a fossil seed. This name should not be used where affinities are as much in evidence as they are here. Of course, fossil plants can always be left unnamed, but they then have no taxonomic status or convenient means of reference.

The reason these seeds cannot be assigned to any previously defined genus is because of the poor preservation of the integument within which tissue most of the generic characters of this "order" are expressed.

Trigonocarpolithus typicus Arnold, sp. nov. (figs. 2, 13–16). This species is based upon 10 specimens from the Big Chief No. 8 mine at St. Charles, in shale collected by the author about 1930. All the specimens are fairly uniform in size, and range from 3 to 4.5 mm. in diameter and from 6 to 7 mm. in length. They are oval or slightly ovate in shape, usually broadest above the middle, and have a rounded base and an obtuse, cuspidate apex. The small apical tip represents the lining of the lower part of the micropyle. The outermost cuticular layer, which represents the lining of the integumentary cavity, is light yellow in color, and shows the pattern of a layer of slender, vertically elongated cells having small cross diameters. The cell outlines are not very distinct, and fragments of the tissue originally adjoining them on the outside are frequently present but not well preserved. In fact, the entire outer surface is somewhat rough owing to former cell attachments. At the very base of the body is an opening slightly less than 1 mm. in diameter, which is sometimes filled with black material, and through which the tissue of the nucellus was attached to the integument (fig. 13). The edge of this opening is ornamented with a fringe of hair-like cuticular projections.

Enclosed by the integumentary cuticle is the cuticular membrane which surrounded the nucellus. This is similar in shape to the cavity within which it is contained but in most instances has shrunk somewhat and is smaller (figs. 13–16). It is attached at the base and terminates in the upper part of

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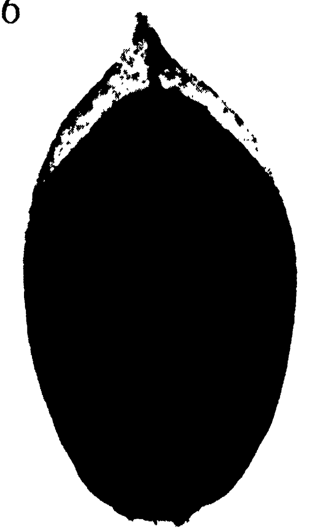

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FIGS. 13, 14. *Trigonocarpolithus typicus* gen. et sp. nov. × 10. FIG. 15. *T. typicus* gen. et sp. nov. Apex of nucellar cuticle showing the dome-shaped pollen chamber and the apical beak. × 35. FIG. 16. *T. typicus* gen. et sp. nov. × 10. FIG. 17. *Sphenopteris sp.* (cf. *S. obtusiloba*). × 2.

the enclosure directly beneath the micropylar opening. In some specimens where the shrinkage has been relatively slight the nucellus fills the cavity except in the upper part (fig. 16).

The nucellar cuticle is reddish brown and darker than the enclosing membrane, and stands out conspicuously from it. The apical part is prolonged slightly upward around the pollen chamber (fig. 15), which has the shape of a low, broad bell or an inverted champagne glass. At the apex is a prominent beak which, before shrinkage had altered its position, projected into the base of the micropylar tube. This beak is 225–275 μ long and tapers from a diameter of about 110 μ at the base to 75 μ at the tip. In some specimens where the upper part of the nucellus has collapsed, the beak has fallen away from its original position (fig. 14). Even when displaced, it can usually be located by its shape and dark color among the disorganized contents of the integumentary cavity.

No pollen grains have been seen inside any of the specimens although the space occupied by the pollen chamber is distinct from the other part of the nucellus and stands out from it as a lighter colored area (figs. 13, 16). The upper margin of the female gametophyte cavity can be recognized as the slightly upwardly bulged floor of the pollen chamber. No gametophytic tissue can be recognized although some of the more darkly colored substances within the nucellar sac may be fragments of the thin enclosing spore exine.

The cuticular bodies described here are strikingly similar in form to the inner lining of the integument and the orthotropous nucellus of the seed often figured as *Trigonocarpus Parkinsonii*. It differs from this seed in being smaller and more broadly oval.

One of the specimens from St. Charles shows a small portion of the integument still attached to the micropylar end, and from this it is possible to form some idea of the probable shape of the original seed as it would have appeared in longitudinal section (fig. 2). The long micropyle of the type usually shown in *Trigonocarpus* is apparently lacking, and the integument appears to have been of fairly uniform thickness. In the part preserved, the integument is about 0.75 mm. thick. No cell structure is revealed. The micropyle is full of opaque material and a small portion is broken away from the extreme apex.

If that part of the integument preserved in this specimen is representative of the tissue in a complete seed, the seed was an oval body about 5 mm. in diameter and 7 or 9 mm. long. Although obviously a member of the Trigonocarpales, it is smaller than the typical members. Nothing is known of the shape of the seed as it would have appeared in cross section.

SEMINA INCERTAE SEDIS. Under the heading of "Semina Incertae Sedis" three fossils are described which are evidently seed remains but

which cannot be assigned to any particular group. In order that they may have taxonomic status they are referred to the form-genus *Spermatites* which was proposed by Miner (3) for similarly preserved objects believed to be seeds from the Upper Cretaceous of Greenland. No relationship, however, with the Greenland fossils is implied. The name is chosen in preference to *Carpolithus* which has been widely used for any kind of seed or seedlike object preserved in any form. Although our seeds do not conform to *Spermatites* exactly as Miner defined it, the name is entirely appropriate as it was intended to provide a convenient designation for any unassigned seeds or ovules for which no suitable name exists.

Spermatites reticulatus Arnold, sp. nov. (figs. 6, 8, 11, 12). This very distinctive seed cuticle is abundant at all three localities. The saclike body is an oval object ranging from 1568 to 2274 μ in diameter and from 2274 to 3058 μ in length. It is broadest at the middle, with an evenly rounded base and a somewhat flattened apex which is terminated by a short blunt papilla about 182 μ broad and 90 μ high (fig. 11). In complete specimens the apex is covered by a low conical cap with a terminal ostiole (figs. 6, 8, 12) which hides the papilla.

The cutinized membrane constituting the body is thin and of light amber color. The cellular pattern is peculiar. The cell outlines are irregularly angular, measuring as much as 154 by 318 μ, and usually with the longer dimension transverse to the long axis (figs. 6, 12). The pattern consists of a system of surface reticulations which, as one may see by examining the edge, are slightly raised. These reticulations are about 15 μ thick. Being low surface ridges, one might conclude that they represent the material filling the crevices between the original cells and that the whole sac is the inner lining of tissue enclosing a cavity similar to the integumentary cavity of *Trigonocarpolithus typicus,* previously described. This interpretation, however, is questioned because the clean outer surface of the sac and the complete absence of adhering tissue fragments would indicate that this surface represents the original outer one of the tissue of which it was a part. The reticulations may be the result of shrinkage of the thinner portions on the cell surfaces.

The membranaceous sacs are somewhat folded and crumpled from flattening, and most of them are empty (fig. 12). Within a few specimens an oval noncellular body is visible, slightly darker than the enclosing jacket, that resembles a large spore. In one specimen (fig. 6) the outer envelope showing the surface pattern measures 2274 by 2705 μ in breadth and length, and encloses a large spore that extends the full length of the internal cavity. Its width, however, is slightly less, only 1803 μ. This enclosed body is somewhat creased as a result of flattening, and originally it probably filled the space. At the apex of the sac is the short papilla, which has been pushed slightly downward.

The conical cap which crowns the apex is loosely attached (figs. 8, 12). In many specimens only fragments of it remain, and in some it has completely disappeared (fig. 11). The cap is circular at the base, and ranges from 1250 to 1750 μ in diameter, depending upon the size of the sac. The lateral margins slope upward forming an angle slightly greater than 90° to each other, and the tip is prolonged into a short tube which, though not found complete, is at least 180 μ high and 110 μ broad (fig. 8). In another specimen the tube is broken off leaving an apical pore 88 μ in diameter (fig. 12). The tube is lighter-colored and more delicately constructed than the part below it.

The cells of the cap below the apical tube are elongated lengthwise and converge toward the opening. These cells are quite irregular, but they average about 30 μ in width. Those nearest the apex of the cone are only slightly longer than broad. Lower down they become longer, some being as much as 250 μ long. At the basal margin there is a border of nearly isodiametric cells.

Situated as it is over the apex of the closed sac, the conical cap is evidently a structure designed for the reception of pollen. In one specimen a few probable pollen grains can be seen within, two of which measure 46 by 73 μ and 46 by 76 μ. They are broadly oval but nothing is visible within them. These bodies are never present in large numbers and whether they are the pollen of the same plant to which the seed belongs, or extraneous material, is unknown. However, they are all of nearly uniform size, and could readily have passed through the opening in the apical tube. If their presence is purely accidental, one would expect to find among them objects of smaller size.

These cutinized sacs are evidently portions of seeds. The probability that they are cryptogamic sporangia is militated against by their structure and by the absence of small spores inside the main cavity. What is apparently a single large spore occupying most of the space within is strongly suggestive of the seed spore of some primitive pteridosperm. The presence of the small apical papilla beneath the apical cap suggests nucellar tissue. Whether this papilla originally projected into the opening of the cap is unknown, but from its position and relation to the cap (which evidently enclosed a pollen chamber), it bears much resemblance to the "tent pole" of the *Ginkgo* ovule or to the upward prolongation of the nucellar tissue in *Physostoma* and other seeds of the Lagenostomales complex.

A puzzling feature shown by these sacs is the absence of any evidence of basal attachment. The membrane is complete over the rounded base. If these objects belong to the Trigonocarpales, as one might suspect from the apparently free nucellar surface, there should be an opening at the base where the nucellus was attached at the bottom of the integumentary cavity. Affinity with the Lagenostomales would be indicated if there were any tissue

fragments adhering to the outer surface, in which case the cuticle would be comparable to the inner layer surrounding the "embryo sac" described for *Physostoma Winchellii.* The situation exhibited here reminds one of Loubière's description of *Leptotesta,* the seed of *Pecopteris Pluckeneti* (2). In this seed the nucellus is described as being free at the base as well as along the sides, the only attachment being by means of a collar near the apex. Too little is known of *Leptotesta* or *Spermatites reticulatus* to warrant any assumption of identity, although the possibility should not be ignored that the kind of structure described for *Leptotesta* might, under certain conditions of preservation, produce the type of fossil described here.

Spermatites globosus Arnold, sp. nov. (fig. 10). This type, represented by only a few specimens, consists of a large, rather thick-walled spore invested by a delicate thin-walled cellular membrane. The spore, which measures 3.0 by 3.2 mm., is nearly round, although it is slightly prolonged at each end. The shape somewhat recalls that of a naval orange. The wall is about 12 μ thick, smooth, and light yellow in color.

On the best preserved specimen (fig. 10) the tissue investing the huge spore is very light colored and rather fragmentary. The cells of the tissue layer adjacent the spore are nearly rectangular, averaging about 36 by 40 μ, and have the longer dimension lengthwise. At the apex the investing tissue is prolonged into a narrow protrusion which cannot be accurately measured because it is incomplete. Whether it is tubular is not certain but the transparency of the cells suggests that it is. Neither pollen chamber nor pollen grains are visible.

This somewhat problematic structure is suggestive of a primitive ovule with a single large spore enclosed by a delicate nucellus. Primitiveness is indicated by the thick spore wall. It is likely that gametophytic tissue developed within while the spore was still within the sporangium, because the investing tissue renders rather improbable any assumption that the spore was ever free.

Spermatites globosus has been found only in the shales from the Big Chief No. 8 mine at St. Charles.

Spermatites cylix Arnold, sp. nov. (fig. 9). The interesting but puzzling specimen described under the above name appears to be the apical portion of a very large spore. The fragment is 5.5 mm. broad, and judging from the curvature of the margin, the complete body might have been 8.0 mm. in diameter. There is no basis for estimating its length. A peculiar feature is the short, columnar apical projection which is about 0.4 mm. broad and nearly 0.75 mm. high. This necklike column is filled with opaque material which has oozed out of the end in a mushroom-shaped mass. The neck appears originally to have fitted into a micropylar opening. The opaque contents obscure structural details so it is not impossible that the neck is separate

from the main part of the spore body, but there is no evidence of connection of two parts along the smooth margin.

The spore body consists of smooth, heavily cutinized exine without recognizable surface ornamentations. Although its thickness cannot be measured, the exine appears to be relatively thin. Fragments of delicate cellular tissue adhere to the exine in places. The cells are irregular in shape, but tend to be rectangular, and they vary from 20 to 55 μ in diameter by 50 to 100 μ in length. There is a definite inverse relation between breadth and length, the narrow cells being longer than the broader ones.

Although the morphology of the above described object is questionable, it appears to represent a fragment of a very large spore of some primitive pteridospermous seed. The black material bulging from the narrow neck reminds one of the gametophytic tissue that swells through the cracks of some lycopodiaceous spores. It is not likely, however, that this is a lycopod, but it may be a stage in seed development on a level with an advanced lycopod.

The only specimen so far found came from the Big Chief No. 8 mine at St. Charles.

SUMMARY

The foregoing account is concerned with compressed seeds preserved as thin cuticle layers that originally enclosed or lined tissues within seed, and large sporelike bodies believed to represent embryo sacs. They are preserved in carbonaceous shales from the Saginaw group of lower Pennsylvanian age, in southern Michigan. The material was prepared for study by softening the shale in dilute nitric acid, and then macerating the individual specimens in Schulze's reagent. Diaphane was the mounting medium.

Physostoma Winchellii sp. nov., a representative of the Lagenostomales, is a small oval body averaging about 1 by 2 mm. in breadth and length, and consists mainly of a layer believed to represent the tapetum of the "embryo sac." Its dome-shaped apex indents the bottom of the pollen chamber in which nearly spherical pollen grains are sometimes preserved. There is a general resemblance to *Physostoma elegans,* but the complete seed was smaller and slightly broader in proportion to its length.

Trigonocarpolithus typicus gen. & sp. nov. is a member of the Trigonocarpales, but lacks features essential for identification with any known genus. The outer covering represents the lining of the inner surface of the integument, and the enclosed nucellar cuticle, which is free from the integument except at the base, shows a well developed pollen chamber bearing an apical beak. The reconstructed seed is an oval body about 5 mm. in diameter and 7–9 mm. in length. Its structure was essentially like that of *Trigonocarpus* and *Pachytesta.*

Three other objects, believed to represent parts of seeds, are assigned to

the form-genus *Spermatites*. *Spermatites reticulatus* sp. nov. is a barrel-shaped body having a maximum length of about 3 mm. which shows a characteristic cellular pattern. The outer surface is believed to represent the nucellar surface but there is no evidence of lateral or basal attachment. A single large spore nearly fills the internal space. The cone-shaped pollen chamber contains a few pollen grains. *Spermatites globosus* sp. nov. is a large, thick-walled, nearly globular spore invested by a delicate cellular layer believed to be the nucellus. The spore is neary 3 mm. broad and of slightly greater length. *Spermatites cylix* sp. nov. is the fragment of a very large but apparently thin-walled spore with a short, stout apical neck through which the enclosed gametophyte possibly came in contact with the external environment. Its morphology, however, is questionable.

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Literature Cited

1. **Harris, T. M.** The fossil flora of Scoresby Sound, East Greenland. Part 4: Ginkgoales, Coniferales, Lycopodiales and isolated fructifications. Medd. Grønland **112** (1). 1935.
2. **Loubière, A.** Étude anatomique et comparée du *Leptotesta Grand'Euryi* gen. nov., sp. nov. (graine silicifiée du *Pecopteris Pluckeneti* Schlotheim). Rev. Gen. Bot. **41**: 593–605. 1929.
3. **Miner, E. L.** Paleobotanical examination of Cretaceous and Tertiary coal. I. Cretaceous coals from Greenland. Am. Midl. Nat. **16**: 585–606. 1935.
4. **Oliver, F. W.** On *Physostoma elegans*, Williamson, an archaic type of seed from the Paleozoic rocks. Ann. Bot. **23**: 73–116. 1909.
5. **Seward, A. C.** Fossil plants (Ch. XXXV). **3**. Cambridge. 1917.
6. **Thomson, R. B.** Is the embryo sac a megaspore? Science **74**: 544–545. 1931.

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GAMETOPHYTE DEVELOPMENT IN TAXUS CUSPIDATA

CLARENCE STERLING

The position of the Taxaceae in the Coniferales has long been contended. Particularly in *Taxus*, the simplicity of ovular organization as well as the uniqueness of construction of the microsporophylls are variously interpreted. These characteristics have been indicated as primitiveness on the one hand and as reduction on the other. Admittedly, embryology may not be decisive in determining phylogenetic relationships. Nevertheless, a consideration of the reproductive morphology in a member of this family cannot fail to be of value in elucidating its relative position. In view of the differences in embryological development which have been found among the various species of *Torreya* (Robertson 1904a, b; Coulter & Land 1905; Buchholz 1940; Tahara 1940) and among those of *Cephalotaxus* (Arnoldi 1900; Coker 1907; Lawson 1907), added interest attends the study of a hitherto unexplored species of *Taxus*.

Materials and Methods. Ovules of *Taxus cuspidata* Sieb. & Zucc. were collected from ornamental plantings on the campus of the University of Illinois in Urbana, Illinois. Collections were made at weekly intervals from April 7 to September 1 during 1946, and additional mature seeds were taken on September 29 and October 19 of the same year. The chronology of development was checked with further collections in 1947. Embryo sacs were dissected out and studied as whole mounts. In addition, many ovules were exposed on two sides and immersed in Carnoy's fluid. After this procedure, these ovules were cleared in chloroform and embedded in paraffin. Sections were cut at 10 μ and stained principally with tannic acid–iron chloride, acid fuchsin, and fast green.

Megasporogenesis. Pollination occurred about March 15–20 in 1946.[1] When the first collections were made a few weeks later, the pollen grains had germinated, and short tubes had penetrated the irregular apex of the nucellus. At this time, the ovules varied in their rate of development. In some, megaspores were already 4-nucleate; in others, meiosis had not yet occurred; but in all the micropyle was completely closed (fig. 17).

At the time of megasporocyte differentiation, the cell rows of the nucellus appear to have a coaxial[2] aspect (as noted by Strasburger 1879, 1904, and

[1] About a month later (April 10–15) in 1947. The chronology of development in 1947 was generally about a month later for all phases of reproductive activity.

[2] Recently, Foster (1943) has discussed the histogenesis of the coaxial type of structure in the shoot apex of *Microcycas*.

Jäger 1899), in which the cell lineages from above converge downward toward the center of the structure. In the upper half of the nucellus, the cells are isodiametric and have large vacuoles. They are larger and have thicker walls than the smaller, more densely-staining cells of the lower half. These latter are meristematic, dividing principally by transverse walls.

At the approximate juncture of these two zones is differentiated a small central area of about 20 cells, as seen in longisection (fig. 14). These cells are at the lower terminus of the coaxial rows mentioned above and are continuous with those rows, as described also by Dupler (1917, 1920). Possibly this area may be designated as sporogenous tissue. Its cells stain much more deeply than their neighbors; their cytoplasm is denser; and they have a higher nuclear : cytoplasmic ratio. They are further characterized by containing one or two large, very darkly-staining bodies in the cytoplasm, usually toward the end(s) of the cells (figs. 2, 4, 14). These bodies have also been noted by Coker (1904) and Strasburger (1904). Similar structures have been reported in the megaspore-mother cells of *Torreya* (Robertson 1904a), *Juniperus* (Norén 1907; Ottley 1909; Nichols 1910; Mathews 1939), *Widdringtonia* (Saxton 1910), *Fitzroya* (Doyle & Saxton 1933), *Taxosium* (Coker 1903), and *Larix* (Juel 1900). In the absence of cytological information concerning their function, the localization of these dense areas in the megasporocytes is of uncertain significance.

It is evident that the rows of sporogenous cells are related to the more lightly-staining files of vegetative cells in the upper half of the nucellus above, having arisen by successive transverse divisions in the cells of these files. However, since the sporogenous cells are set off from their sister vegetative cells only by virtue of their position, it appears quite likely that the influence of the whole organ is more decisive for the differentiation of these cells than a presumed origin from an archesporial cell or group of cells.

Differentiation of the sporogenous tissue is accompanied by divisions in the neighboring cells, parallel to the periphery of this tissue. In addition, some tangential divisions occur also in the more peripheral cells of the sporogenous group. The cells produced by these divisions do not enlarge, and consequently their origin is easily ascertained. Repeated parallel divisions give rise to rows of cells which appear to radiate from the central area, creating the configuration of a concentric grouping of surrounding cells (figs. 1–5). This configuration is most marked above the sporogenous area. It is independent of the original cell pattern, resembling fiber origin in the gourds of *Luffa* (Sinnott & Bloch 1943).

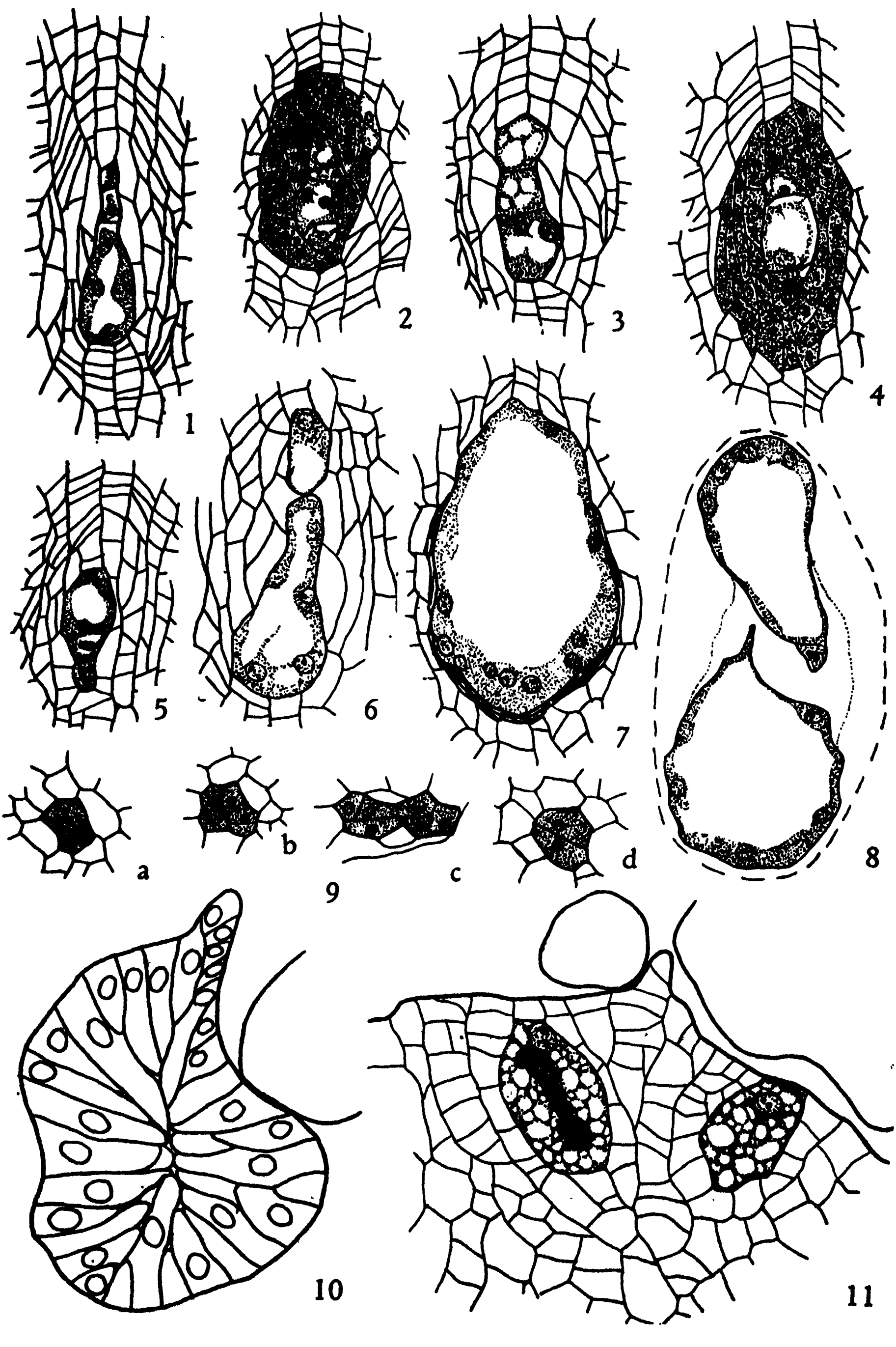
Although ovules were often seen in which two or even three sporogenous cells had enlarged and could possibly qualify as megaspore-mother cells, more than one linear row of megaspores was not found during the present investigation. The possibility of an occasional case of plurality of mother

cells cannot be ruled out, but it is obvious that such a condition is relatively uncommon. (Strasburger in 1879 and 1904 reported 3–5 mother cells in *Taxus*, and both Jäger in 1899 and Dupler in 1917 noted that occasionally two megaspore-mother cells undergo meiosis.) Generally one cell, approximately in the center of the sporogenous group, becomes the functional megasporocyte, as was also found by Coker (1904).

The meiotic divisions occur mainly from about the time of pollination to several weeks later. Some ovules appeared to be delayed in development, and both sporogenous tissue and linear tetrads of spores were found as late as May 12, almost two months after pollination. Because of the intensive study of Strasburger (1904) and the well documented observations of others, the meiotic divisions were not studied in detail. A metaphase figure of the first reducing division is shown in figure 12. The end result of meiosis in *Taxus* has been variously described as three (Hofmeister 1862; Strasburger 1879) and four (Coker 1904; Strasburger 1904; Dupler 1917) megaspores. Both conditions seem to occur commonly in *Taxus cuspidata* (figs. 1–5), and Jäger (1899) has also noted this variation in *T. baccata*. Depending on the shape of the mother cell, the form of the spores in the linear group may vary from tabular to elongated.

Megagametophyte Development. As a result of the investigations of Hofmeister (1862), Dupler (1917), and others, it is sufficiently well known that any or all of the megaspores may begin to "germinate" (figs. 1–6, 8). Most commonly, however, it is the larger, most chalazally situated spore which is functional. The functional spores may enlarge while still uninucleate and soon acquire a large central vacuole before the nucleus divides (fig. 4). In other cases, the nucleus may divide once or twice before the enlarging vacuoles of the megaspore coalesce to form the central vacuole (figs. 2, 3). As the functional spore enlarges, the non-functional ones disintegrate, and their contents appear to be resorbed. Although as many as three spores were seen to germinate (fig. 3), usually only one continues development beyond the uninucleate stage. The presence of two active megagametophytes in an ovule is sufficiently uncommon to be remarked (figs. 6, 8). In a sampling of 250 ovules, only 14 possessed two developing prothalli. None were found with more than two gametophytes. This is to be contrasted with the rather common occurrence of supernumerary gametophytes in *T. canadensis* (Dupler 1917).

The megaspore enlarges downwardly and laterally at the expense of the original sporogenous tissue, whose cells break down and finally disappear (fig. 7). No tapetum is formed; after the sporogenous cells are dissolved, the embryo-sac comes into contact with the ordinary vegetative cells of the nucellus and attacks them in the same manner. This localized growth of the gametophyte gives it the flask-shaped form (with a tentpole-like tip) shown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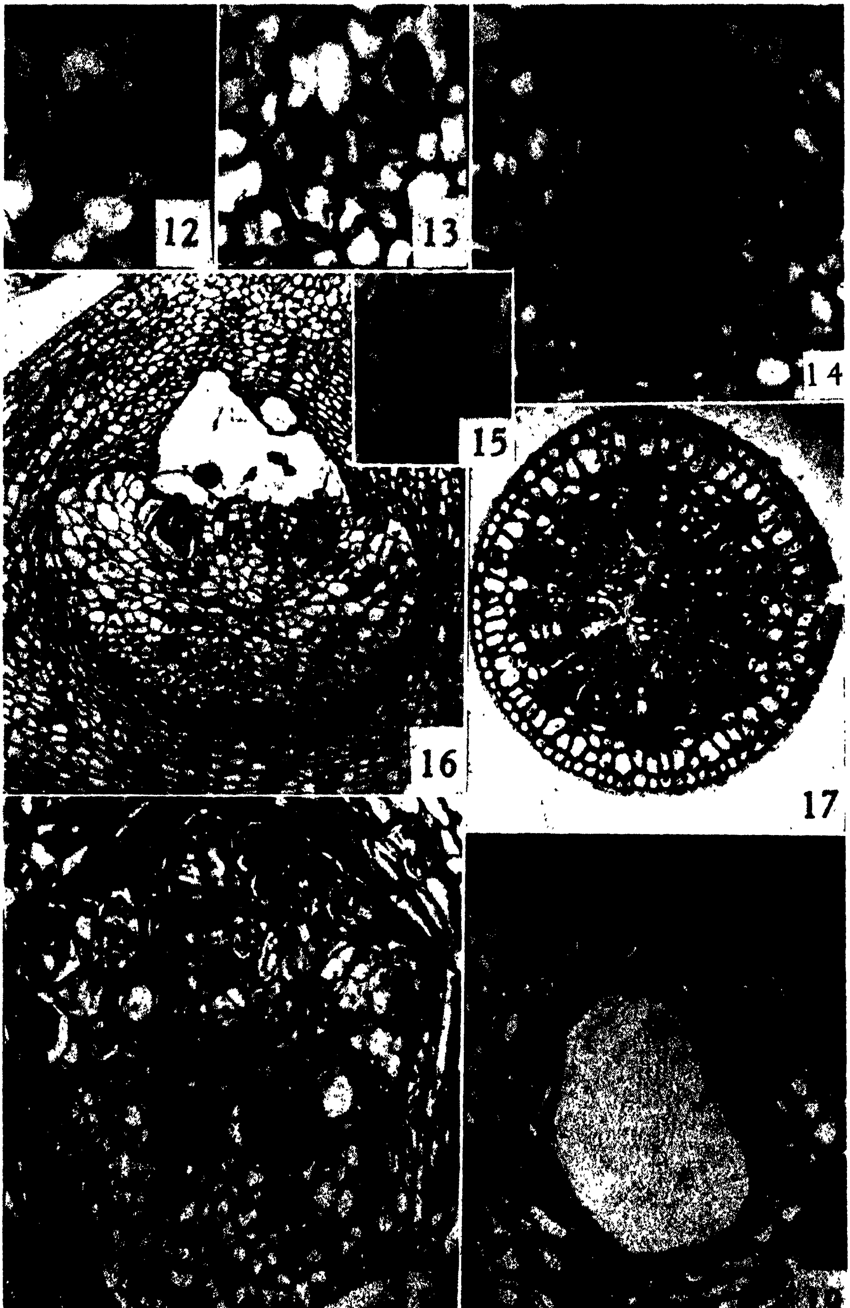
by Schacht (1850), Hofmeister (1862), Sokolowa (1891), Jäger (1899), Dupler (1917), and Saxton (1936). The same shape of the developing embryo-sac has also been described in *Torreya* (Coulter & Land 1905), *Cephalotaxus* (Sahni 1921), *Acmopyle* (Sahni 1920), *Austrotaxus* (Saxton 1934), *Saxegothaea* (Looby & Doyle 1939), and *Widdringtonia* (Saxton 1910). Sahni (1921) has commented at length on the parallel structure in the paleozoic Cordaitales.

The micropylar tip of the gametophyte does not enlarge at the expense of the surrounding tissues. Hence the original sporogenous area in this region is maintained as a deeply-staining, more or less inactive group of cells arranged as a hemispherical cap over the prothallus apex. (There are indications of occasional irregular divisions in the cells of this area.) The concentric arrangement of the nucellar tissue around this group is likewise maintained. When two gametophytes develop, however, the above-mentioned tissue is disintegrated by the growth of the second gametophyte. In this case, the prothalli are usually superposed, the one below behaving as it would if alone. The upper gametophyte, on the other hand, enlarges upwardly, so that its tentpole is directed toward the chalaza and its base toward the micropyle of the ovule (fig. 8).

As the embryo-sac enlarges, the nuclei divide, and numerous free nuclei are produced in the parietal layer of cytoplasm (figs. 1, 6–8, 20). The distribution of gametophytic nuclei often appears correlated with the principal direction of growth of the prothallus; these nuclei are grouped primarily at the enlarging end of the latter (figs. 6, 7). (When a gametophyte is growing upwardly, as when two are present, the nuclei occur at the expanding micropylar region of the upper sac; fig. 8.) It is also to be noted that the

Explanation of figures 1–11

Drawings made by microprojection. Fig. 1. Longisection of three megaspores, showing developing basal functional spore. Concentric divisions in nucellar cells about sporogenous group do not obscure origin of the cell groups in original longitudinal files. Fig. 2. Group of four megaspores in which second spore from chalazal end is functional. Fig. 3. Three megaspores in longisection. All three may be functional, but the basal one already shows a binucleate condition. Fig. 4. Third megaspore from chalazal end is seen enlarging here. The cell has already acquired a central vacuole while uninucleate. Fig. 5. Group of four megaspores, with third spore from chalazal end functional. Fig. 6. Two functional megagametophytes enlarging. Fig. 7. Embryo sac in longisection. Most of the nuclei and associated cytoplasm occur at the chalazal end of the sac, about which are disintegrated remains of nucellar cells. Fig. 8. Two developing embryo sacs with opposed tentpoles. At the chalazal tip of the upper sac appears to be a sterile spore. Fig. 9, a–d. Surface views of necks of mature archegonia, composed of two to four cells. Fig. 10. Megagametophyte in longisection after completion of alveolar development. Nuclei have moved to periphery in each alveole. Sac is indented on right by broadening pollen tube. Fig. 11. Tip of megagametophyte with mature archegonia and showing tentpole. Obliquely cut archegonium at left shows dense cytoplasmic condensation below central cell nucleus. Two branches of a pollen tube are visible over the shoulders of the gametophyte. All figures $\times$ 185. In all longisections, the micropylar end of the ovule is toward the top of the page.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parietal layer of cytoplasm is much thicker in this region of growth than elsewhere. Later, however, the distribution of nuclei and the thickness of the cytoplasmic layer tend to become more uniform (figs. 19, 20) and remain so through the stage of wall formation.

During the free-nuclear stage of prothallus development, there is present about the sac a very thin, tenuous, pliable megaspore membrane. This membrane is often so intimately associated with the surrounding tissue of the nucellus that it can be dissected out only with great difficulty in living material. The existence of such a membrane early in development has also been noted by Thomson (1905) and Dupler (1917). If the embryo-sac encounters no obstacles during the course of its growth in the free-nuclear condition, it is generally pear-shaped or somewhat spherical at the stage of wall formation, being surmounted by the nipple-like tentpole. Frequently, however, the prothallus is distorted during development by the pressure of the down-growing pollen tubes (figs. 10, 21). These have been observed to reach the embryo-sac at all stages of development, from the 4-nucleate condition to the time of archegonial maturity. The pressure of the pollen tube or tubes often indents the tentpole of the prothallial apex. Hence only half of the mature gametophytes may possess a tentpole even though that structure is present in most of the young embryo-sacs. Bizarre shapes are often thus produced by pollen tube indentations. In no case, however, is there an actual "erosive" effect of the tube on the prothallus, as claimed by Hofmeister (1862).

About the end of April, most megagametophytes have a large number of free parietal nuclei. As a rule, wall formation is initiated in the first week in May, when the embryo-sac has attained a transverse diameter of approximately 220 μ, when about 280 nuclei are present (fig. 19). This number of nuclei is calculated roughly by using the formula for the surface of a sphere ($4\pi r^2$). The figure given corresponds well with the one given

Explanation of figures 12–19

FIG. 12. Metaphase of first meiotic division of megaspore mother cell. × 666. FIG. 13. Longisection of two young pollen tubes, with the lightly-staining stalk nucleus shown moving down along the large body cell. The tube nucleus is at the base of the body cell in the pollen tube at the left and is just out of the plane of section in the one at the right. × 300. FIG. 14. Group of sporogenous cells in nucellus, showing darkly-staining cytoplasmic condensations. × 300. FIG. 15. Mature archegonium, cut obliquely, showing deeply-staining cytoplasmic configuration below central cell nucleus. × 150. FIG. 16. Longisection of megagametophyte with mature archegonia. Two unequal sperm cells have been formed, and the egg nuclei are central, surrounded by a dense cytoplasmic sheath. Note active cells at chalazal surface of prothallus. × 75. FIG. 17. Transection of integument in region of micropyle, showing closure following pollination. A definite cuticle appears in the commissure. × 75. FIG. 18. Transection of prothallus with numerous (at least 25) archegonia with alveolar cytoplasm. Some archegonia are surrounded by a definite layer of jacket cells. × 150. FIG. 19. Longisection of embryo sac with tentpole at time of wall initiation. × 150.

by Jäger (1899) and Dupler (1917). They report 256 nuclei before wall formation, on the basis of eight successive, simultaneous nuclear divisions. The latter figure can therefore be accepted in the present study.

As with other phases of megagametophyte development, there is a variation of over a month among prothalli in the date of wall inception. It is unnecessary to repeat in detail the pioneering description of Sokolowa (1891), which has since been confirmed by Dupler (1917). Jäger's (1899) description and figure gives an erroneous impression of this process and has been so criticized (Dupler 1917). Wall formation is obviously accomplished by means of undivided, ingrowing, tube-like alveoles, open at their inner ends (fig. 21). The alveolar walls form a honeycomb-like structure, in each hexagonal cell of which occurs one of the prothallial nuclei.

The nuclei advance inwardly at the actively growing ends of their respective alveoles. When the alveoles are closed, either by being cut off early by the intersection of other alveoles or ultimately by meeting opposed alveoles in the central line of the prothallus, the nuclei retire to the peripheral ends of the long prismatic cells (fig. 10). Then follows immediately the cutting up of each alveole into a file of smaller cells (all uninucleate) by successive mitoses, each mitosis being succeeded by wall formation (fig. 22). The alveolar origin of the cells of the gametophyte is long afterwards recognizable by the radial arrangement of many of the cell files (figs. 11, 16, 23).

The first-formed cells of the endosperm usually have large vacuoles, and their cytoplasm stains quite lightly (fig. 22). Subsequent divisions in the megagametophyte occur principally at the micropylar surface and, soon after, at the chalazal surface also. The cells of these regions soon acquire a greater nuclear: cytoplasmic ratio, smaller size, and deeper-staining quality than the remainder of the gametophytic cells. The micropylar zone, with its developing archegonial initials, is generally 3–5 cells deep over the surface of the prothallus (fig. 23).

Following archegonial initiation, mitotic activity in the endosperm cells appears to involve an increase in the number of cells within the original alveolar rows by many tangential divisions and not infrequent radial divisions (figs. 16, 22, 23). As the gametophyte enlarges, it expands at the expense of the basal and lateral nucellar tissue. At the same time, the enlargement of the archegonia at the apex of the prothallus has a widening effect. Hence at the time of fertilization, the gametophyte is often cordate, with the wider region above and an acutely tapering region below. As in *Podocarpus* (Coker 1902) and *Torreya* (Robertson 1904b), the endosperm cells on the expanding periphery of the lower part of the prothallus are smaller and stain more deeply than those more centrally situated (fig. 16).

No funnel-shaped archegonial cavity is formed above the archegonia by

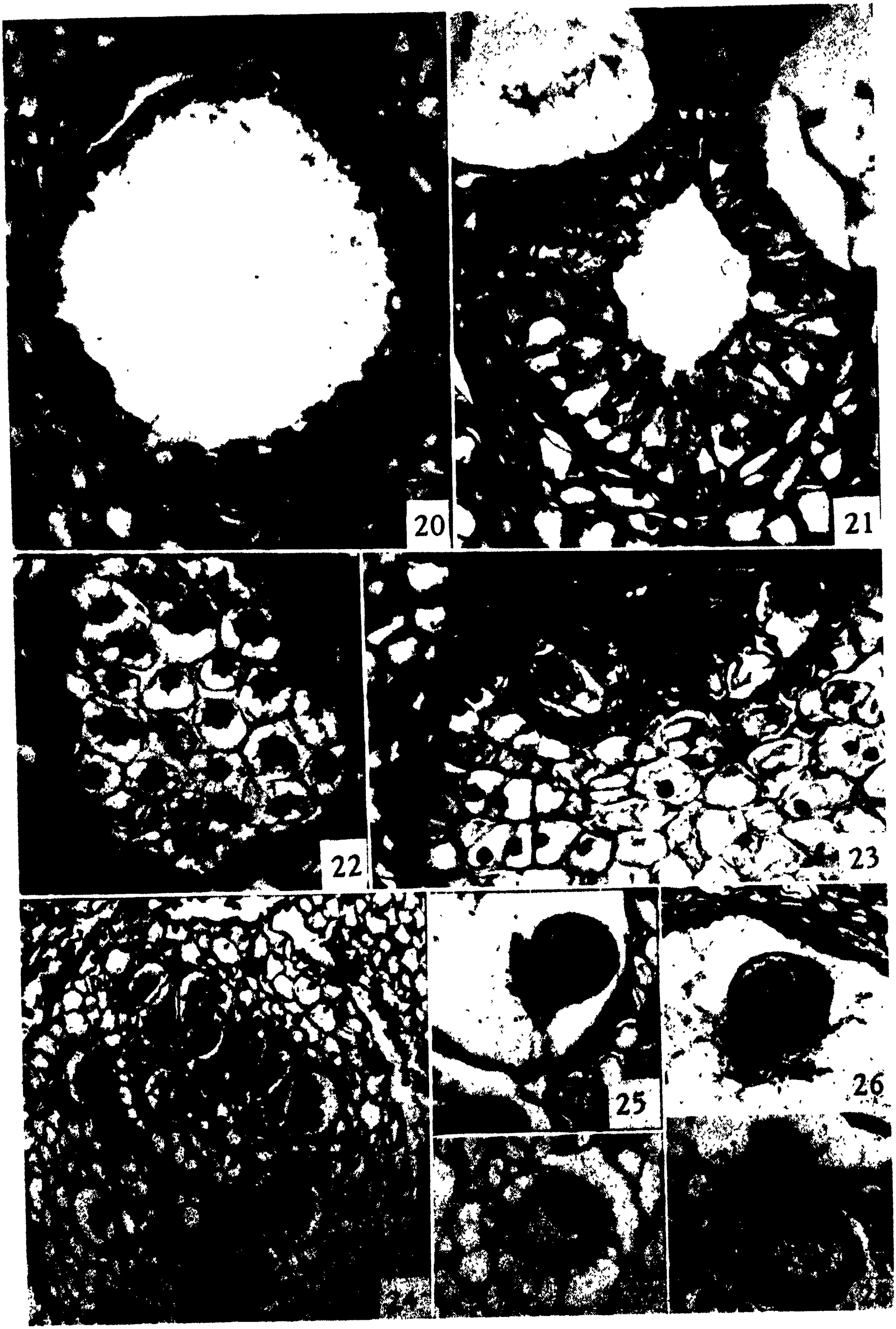
the endosperm cells before fertilization (fig. 16), although such a development appears normal in most conifers. However, this overgrowth of the archegonia by endosperm cells, to produce an archegonial chamber, has not been described for those conifers with lateral archegonia (sequoiads and callitroids). At the time of fertilization, the endosperm cells are all uninucleate, and the nuclei are strikingly variable in size. This size variation appears to be random and cannot superficially be correlated with differences in cell activity.

Archegonial Formation. The cells of the micropylar meristematic area divide principally in a plane parallel to the surface of the prothallus, *i.e.*, by repeated, active periclinal divisions. However, certain superficial cells in this region do not participate in the mitotic activity but gradually elongate as the zone extends in thickness (fig. 23). With enlarging vacuoles in their basal ends, these cells assume the role of archegonial initials. No initials extend to the center of the embryo-sac. If original alveoles are involved in their formation, as seems quite likely because of their shape, these are only those shorter alveoles which are cut off early by the intersection of neighboring ones.

Development appears to be simultaneous in all the initials. Each cuts off a neck-mother cell, which redivides to form from two to four neck cells arranged in a single tier at the apex of the archegonium (fig. 9, a–d). The central cell thus formed continues elongating and acquires an increasingly larger basal vacuole. Its nucleus remains near the neck, surrounded by a dense mass of cytoplasm, from which strands radiate out to the wall of the cell. Soon this nucleus also begins to enlarge in its position just under the neck, surmounting the large vacuole.

At the end of the period of archegonial enlargement (about mid-May) the growing nucleus of the central cell gradually begins to move down to the center of the archegonium. Just before this migration, the cytoplasmic contents of the archegonium undergo a striking series of changes. The cytoplasm in the upper part of the archegonium acquires larger vacuoles and becomes lighter-staining. In the meantime, the large vacuole in the lower end of the cell becomes invaded by cytoplasmic strands which break it up into a foam-like mass of cytoplasm and vacuoles (figs. 11, 18). In this way, the entire archegonium becomes uniformly foam-like, the vacuoles occurring as larger or smaller globules in a tenuous cytoplasmic reticulum. Soon a dense condensation appears temporarily below the central cell nucleus, extending in some cases to the base of the archegonium. This cytoplasmic condensation may be one continuous, deeply-staining strand, or it may assume a variety of peculiar forms (figs. 11, 15).

As the archegonium matures, its cytoplasm becomes gradually more granular and aggregated closely about the central cell nucleus, which becomes the functional egg nucleus. The deeply-staining localized condensation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disappears as the nucleus is surrounded by a densely granular sheath of cytoplasm, in which strands appear to radiate out from the nucleus into the less dense and lighter-staining areas of the cell (figs. 16, 24). In the mature archegonium, there are also spherical, deeply-staining bodies of various sizes irregularly scattered through the cytoplasm. These may be equivalent to the so-called "Hofmeister bodies" of the pinaceous egg cell. Some appear to be the size of nuclei of the endosperm cells, but they stain quite differently from the latter. The neck cells are present at maturity (figs. 9 a–d, 11).

At the time of fertilization, the enlarging egg nucleus has reached the center of the cell and attained a diameter of approximately 40 μ. Only three preparations seen in the present study give any indication of the possibility of the division of the central cell nucleus to form a discrete ventral canal nucleus and an egg nucleus. All other archegonia, which presented similar appearances, were seen to have the two nuclei separated by a very definite (although in some tenuous) membrane which extended completely across the archegonium. In view of the occasional occurrence of a ventral canal nucleus reported in *Torreya* (Robertson 1904b; Tahara 1940) and the possibility of its being formed in *Austrotaxus* (Saxton, 1934), it is possible to consider that the three archegonia observed had actually undergone division of the central cell nucleus. However, it should be mentioned that these archegonia were somewhat abnormal in that two of them appeared to lack a neck and the other showed a peculiarly incomplete separation of the two nuclei. Furthermore, it should be noted that no other investigator has found a ventral canal nucleus in *Taxus*.

Archegonial Distribution. As pointed out by Strasburger (1904), the archegonia tend to occur away from the central region of the prothallial apex (fig. 11). In dissected gametophytes, the archegonia are seen to occur most commonly in a wreath-like arrangement about the invagination produced by a pollen tube. The number of archegonial initials formed, as well as the number which finally matures, varies greatly. As few as 6 and as many as 25 or more archegonia (figs. 18, 24) were found in a gametophyte. The

Explanation of figures 20–28

FIG. 20. Longisection of embryo sac with free nuclei evenly distributed in parietal cytoplasmic layer about central vacuole just prior to wall initiation. ×231. FIG. 21. Inwardly growing alveoles of prothallus in median longisection. Two pollen tubes are indenting shoulders of sac. ×231. FIG. 22. Tangential longisection of embryo sac, with alveoles dividing up. ×231. FIG. 23. Portion of apical region of prothallus in median longisection. Archegonial initials are enlarging after having cut off neck mother cells. A jacket is present about several initials at left and another about the single initial at right. ×231. FIG. 24. Transection of prothallus with 18 mature archegonia. ×116. FIG. 25. Enlarged body cell with 2 sterile nuclei close by. ×231. FIG. 26. Two sperm cells with associated tube cytoplasm and one of the sterile nuclei. ×231. FIGS. 27, 28. Two cases of fertilization, showing indentation of egg nucleus by sperm nucleus. ×231.

usual number appears to vary between 8 and 14. Particularly of interest is the fact that in those prothalli with more than about 12 archegonia, there are many arrested initials, i.e., cuneate cells which have become vacuolate and have deeply-staining, relatively large nuclei. In these cases, all transitions could be found between ordinary "vegetative" prothallial cells and mature archegonia.

The jacket cells do not represent a step in this transition, although such a phenomenon is found in *Cryptomeria* (Arnoldi 1901; Lawson 1904b), *Sequoia* (Lawson 1904a; Buchholz 1939b; Looby & Doyle 1942), and *Sequoiadendron* (Buchholz 1939a; Looby & Doyle 1942). As reported by Schacht (1850), the jacket cells are not often differentiated. They are most obviously developed when but few large archegonia are present, seemingly confirming Lawson's (1940a) speculation that jacket cells are sterile archegonial initials and his inference (1904b) that the degree of jacket specialization is inversely correlated with the number of archegonia formed. However, jackets may be found in prothalli with very numerous archegonia (figs. 18, 24). Jacket cells in *Taxus cuspidata* are generally smaller than their neighbors, with usually a higher nuclear-cytoplasmic ratio. Nevertheless, their cytoplasm is not significantly denser than that of the neighboring endosperm cells. When differentiated, there is but a single layer of jacket cells about an archegonium or group of archegonia (figs. 16, 18, 23, 24).

The shape of the archegonia is also variable and appears to depend on their number and arrangement, as in *Pinus* (Ferguson 1904). When many are crowded together, they are usually elongated and narrow; when isolated from their neighbors, they may become nearly spherical. Some have been seen which appear to be bent at an oblique angle. If few archegonial initials are formed, they are all superficial in origin, and the necks of the archegonia are flush with the prothallus surface (fig. 16). With the advent of numerous initials, many archegonia have a hypodermal situation. Some are directly superposed in a radial line, presumably derived from a periclinal division in a primordial cell (fig. 23). Others may occur just below the surface layer of the gametophyte. These interior archegonia generally lack necks.

Commonly numerous archegonia are crowded closely together and appear to occur in tightly grouped complexes, with several archegonia in direct contact with their neighbors (figs. 18, 23, 24). In no case is the complex as well-developed as in members of the Cupressaceae. However, directly adjoining archegonia are so frequent in the Japanese yew as to appear as a rather constant character. In one instance, a gametophyte was found which had a definitely lateral complex of archegonia in addition to the normal apical group.

When secondary prothalli develop to maturity, archegonia may also be found in these. If the gametophytes are superposed, the archegonia appear

at the chalazal end of the upper one and, like the micropylar ones of the lower prothallus, directly abut on the pollen tube which grows between the gametophytes. In the one case in which two equally developed prothalli were juxtaposed, archegonia occurred at the micropylar end of each.

Microgametophyte Development. The history of the male gametophyte from pollination to fertilization is well known from the investigations of Strasburger (1892), Belajeff (1891), Jäger (1899), and Dupler (1917). Observations made on the development of the pollen tube during the present study agree quite closely with the data reported by these investigators.

The youngest tubes seen, several weeks after pollination, had already penetrated a little distance into the nucellus. The tube nucleus was near the tip of the pollen tube while the generative cell remained within the cavity of the grain. (Some tubes at this time had already reached the megaspore tetrad, as also reported by Coker in 1903.) After the division of the generative cell, the body cell and the stalk nucleus were found in the pollen tube close behind the tube nucleus (fig. 13). At this time, April 9, the embryo sacs were generally 2–8-nucleate, and the tubes had penetrated about a third of the distance from the nucellar apex to the female gametophyte.

The stalk nucleus apparently does not separate from the body cell but remains closely applied to it while the two are passing down the tube. The body cell is more or less conical, with its enlarging nucleus at the downwardly directed base. The stalk nucleus, at first at the distal vertex of the body cell, soon moves down along the latter (still closely applied to it; fig. 13) and eventually passes it. The stalk nucleus then moves to a position abreast the tube nucleus, both nuclei just ahead of the enlarging body cell. Most tubes were found in this condition about April 21. The two sterile nuclei, embedded in the abundant cytoplasm just behind the tip of the tube, very soon become alike in size and structure.

The complex of two sterile nuclei and body cell is situated near the growing end of the tube, generally about twice the distance of the tube diameter away from the tip. Up to this time, the tube diameter has been increasing only gradually. The body cell is found at the upper limit of the dense tube cytoplasm. Above this point, the tube lumen appears empty in sectioned material, but it is probably filled with vacuolar fluid in the living condition. The body cell then becomes more and more spherical, enlarging greatly all the time. Its cell membrane becomes more distinct and its cytoplasm exceedingly dense and very tenacious of stains, so that little structural detail is visible. The body cell nucleus occupies an eccentric position in the cell, generally located on the side of the cell diametrically opposite the position of the two sterile nuclei. Before marked tube expansion, the sterile nuclei are usually below the body cell, but in later stages, the relative positions of these may be greatly altered. Thus, the whole complex may revolve as

much as 180° about its horizontal axis, so that the sterile nuclei appear above the body cell. This condition has also been reported by Coulter (1897) and others.

On reaching the prothallus, the tip of the tube begins to widen rapidly and forms a sac-like expansion which may cover the entire prothallus apex. The body cell enlarges to about 60 μ in diameter, its cytoplasm becoming even more dense than previously and contrasting markedly with the lightly staining nucleus (fig. 25). Then the body cell divides into two quite unequal male cells, as has been described in detail by Belajeff (1891), Strasburger (1892), Jäger (1899), Robertson (1907), and Dupler (1917). Such a result of body cell division is also described for *Torreya* (Coulter & Land 1905; Robertson 1907) and *Podocarpus* (Looby & Doyle 1944, and others). The time of this division is variable: the body cell has been found already divided as early as May 12 and still undivided on June 2 and later (of the same year). The sperm cells become mature and are ready for fertilization. The previously dense cytoplasm at the tip of the tube has become vacuolated during the latter's expansion, and little cytoplasm surrounds the antheridial group. The sterile nuclei are still visible at sperm maturity (fig. 26).

Pollen Tube Development. Since the pollen tube is an integral part of the male gametophyte, its development is related to the functional behavior of the sex cells. However, ovules are often found in which the pollen tubes have produced sperm cells and no megagametophyte has been formed. As it moves down through the nucellus, the pollen tube slowly widens, sometimes twisting, meandering, and even branching. Just before reaching the embryo sac, the tube often branches once, sending a branch to each side of the sac's tentpole (fig. 11). These branches then expand greatly, either on the shoulders of the gametophyte or over its apex, often attaining a breadth equal to that of the prothallus itself.

When several tubes arrive at the embryo sac, they may "pile up" on each other, so that the sac-like expansions of successive tubes form a heap above the prothallial apex. The tubes may also, as described by Hofmeister (1862), Dupler (1917), and Saxton (1936), grow down the side of the gametophyte, in some cases meeting each other below the prothallus. The wall of the mature pollen tube is quite thick, as can be noted when shrinkage has taken place or when the wall has been dragged slightly in sectioning (fig. 16).

Fertilization. In concordance with the variability in gametophyte development, the time of fertilization extends over a month or more, with the first evidence of fertilization found on May 12. At maturity, the contents of the pollen tube are discharged almost completely into an archegonium. Rarely is any portion of the antheridial complex left behind in the tube. In fertilized eggs, it is often possible to detect three supernumerary nuclei

in the cytoplasm at the top of the egg, these being the two sterile nuclei and the non-functional sperm. In one case (fig. 28), a mass of cytoplasmic remains was found just outside the archegonium. It was not possible to determine the morphological nature of this mass.

When the tube contents have entered the egg cell, the functional sperm nucleus meets the egg nucleus in the center of the egg. This movement is probably rapid, since the cytoplasm above the uniting nuclei is filled with large vacuoles and presents a much disturbed appearance (fig. 28). The male nucleus sinks into the female (figs. 27, 28), and the two nuclei, with their boundaries still intact, usually move to the base of the egg. The male nucleus stains much more deeply than the female and appears to be filled with a dense concentration of granular material (figs. 27, 28). The egg nucleus is noticeably larger than the sperm nucleus.

In those eggs which are unfertilized, the female nucleus remains for some time in the center of the cell, large, lightly-staining, and surrounded by a cytoplasmic mantle. After a period of time, the nucleus begins to move downward toward the base of the egg, enlarging and becoming very irregular in outline during this passage. Evaginations at various points along the nuclear surface produce a pock-marked configuration at first. Eventually the nucleus loses its spherical form entirely as it assumes a variety of amoeboid shapes. The archegonium disintegrates completely soon after this stage. Subsequently it is overgrown and resorbed by the encroachment of the surrounding prothallial cells.

DISCUSSION

With reference to the general outline of gametophyte development, the present paper has served to corroborate most of the data previously presented. In the main, the gametophytes of *Taxus cuspidata* differ only slightly from those of *T. baccata*. The most significant differences shown by the Japanese yew are in the number and distribution of archegonia. In *T. baccata*, 5–11 archegonia occur (Gottsche 1845; Schacht 1850; Hofmeister 1862; Jäger 1899; Strasburger 1904); and in *T. canadensis*, 4–8 (Dupler 1917). In *T. cuspidata*, however, the archegonia are commonly very numerous, ranging from 6 to 25 or more in number. Robertson (1907) has noted an instance in *T. baccata*, in which there were up to 17 archegonia in a prothallus, but this record appears to be the only one of so many archegonia for that species.

Although Hofmeister (1862), Robertson (1907), and Dupler (1917) found that two archegonia in immediate contact were sufficiently rare to be remarked upon, Schacht (1850) showed 4 archegonia in direct contact in a row and noted that such complexes occurred as often as not in *T. baccata*. Likewise, Jäger (1899) described the archegonia as occurring in wreaths, bundles, rows, etc. In *T. cuspidata* the majority of gametophytes generally

shows a condition bordering upon a definite complex of archegonia. This may be somewhat comparable to the wreathlike arrangement described for *Cunninghamia* (Miyake 1910).

The occurrence of an occasional lateral group of archegonia in addition to the normal apical group is of doubtful phylogenetic significance in *Taxus*. Such lateral groups have also been reported in *Tetraclinis* (Juel 1904; Norén 1907; Saxton 1913b), *Fitzroya* (Doyle & Saxton 1933) and *Juniperus* (Hofmeister 1862; Norén 1907) on occasion. They have also been found abnormally in several other genera.

In the structure of the conifer megagametophyte, one of the most heavily weighted considerations in morphology is the organization of the archegonium. The Pinaceae are characterized by the formation of a ventral canal *cell,* which is separated from the egg cell by a definite membrane. In virtually all the other members of the Coniferales, the division of the central cell nucleus is not attended by cell wall formation, and the ventral canal nucleus lies free in the cytoplasm of the egg cell. In some specialized genera, the formation of even a ventral canal nucleus appears to have been suppressed. In these forms the central cell functions directly as the egg cell and the central cell nucleus as the egg nucleus.

Some investigators, however, have found the occasional formation of ventral canal nuclei (often in abnormal conditions) in these specialized genera. Robertson (1904b) and Tahara (1940) have found them in two species of *Torreya*. Similarly Saxton has described the formation of a ventral canal nucleus in *Widdringtonia* (1910) and its abnormal occurrence in *Actinostrobus* (1913a). In the present investigation, the occasional division of the central cell nucleus is regarded as abnormal in *Taxus cuspidata*.

The Taxaceae exhibit an interesting contrast to the other conifers, particularly the Pinaceae, in the overall period of megagametophyte development. Whereas the pine gametophyte is generally full-sized or nearly so at fertilization, the taxoid prothallus is relatively quite small when compared to its size at maturity. The major part of endosperm growth occurs subsequent to fertilization in *Taxus* and *Torreya*. In *Taxus,* the whole embryology, from megaspore formation to seed maturity, takes place within the space of a single season.

The organization of the reproductive structures in *Taxus* has often been discussed with reference to its relative antiquity or modernity. With regard to the organization of the gametophytes of this genus, there seems to be but little doubt that "advanced" features predominae. Thus, the pollen grains are uninucleate and produce no prothallial cells. The organization of but a single functional sperm cell, formation of archegonia in a near-complex, and suppression of ventral canal nucleus formation are likewise features of specialization. The phylogenetic significance of the number of archegonia,

number of germinating megaspores, and degree of jacket cell differentiation is doubtful. Too little is known of primitive conifers to evaluate these characteristics, any of which may be a cenogenetic rather than palingenetic phenomenon.

SUMMARY

Gametophyte development in *Taxus cuspidata* is described from sectioned material and whole mounts. The chronology of development is variable, and some phases may be found during a period of almost two months in different ovules on the same plant. Megagametophyte development follows the production of a linear row of three or four spores from a single mother cell embedded in the midst of a group of similar cells—a sporogenous group. About five per cent of the ovules contained two developing embryo sacs; none contained more than two.

The early free-nuclear stage of prothallus development is characterized by the assumption of a flask-shaped form of the sac and the aggregation of most of the nuclei and cytoplasm at its basal, growing end. A tapetum is absent in this growth. Wall formation is initiated at the stage of about 256 free nuclei and proceeds by means of open, ingrowing alveoles. From 6 to over 25 archegonia may be formed, many closely grouped into complexes. Jacket cell differentiation is usually indefinite, and a ventral canal nucleus is rarely, if ever, formed.

Pollen tube and male gametophyte development are as reported for other species of *Taxus*. Fertilization is briefly described, including the usual entry of all the tube contents into an archegonium and copulation of the two unequal-sized sexual nuclei in the center of the archegonium.

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Literature Cited

Arnoldi, W. 1900. Beiträge zur Morphologie der Gymnospermen. III. Embryogenie von *Cephalotaxus Fortunei*. Flora **87:** 46–63.

————. 1901. Beiträge zur Morphologie der Gymnospermen. V. Weitere Untersuchungen der Embryogenie in der Familie der Sequoiaceen. Bull. Soc. Imp. Nat. Moscou **14:** 449–476. (1900:)

Belajeff, W. C. 1891. Zur Lehre von dem Pollenschlauche der Gymnospermen. Ber. Deuts. Bot. Ges. **9:** 280–286.

Buchholz, J. T. 1939a. The morphology and embryogeny of *Sequoia gigantea*. Am. Jour. Bot. **26:** 93–101.

————. 1939b. The embryogeny of *Sequoia sempervirens* with a comparison of the Sequoias. Am. Jour. Bot. **26:** 248–257.

————. 1940. The embryogeny of *Torreya*, with a note on *Austrotaxus*. Bull. Torrey Club **67:** 731–754.

Coker, W. C. 1902. Notes on the gametophytes and embryo of *Podocarpus*. Bot. Gaz. **33:** 89–107.

————. 1903. On the gametophytes and embryo of *Taxodium*. Bot. Gaz. **36**: 1–27, 114–140.

————. 1904. On the spores of certain Coniferae. Bot. Gaz. **38**: 206–213.

————. 1907. Fertilization and embryogeny in *Cephalotaxus Fortunei*. Bot. Gaz. **43**: 1–10.

Coulter, J. M. 1897. Notes on the fertilization and embryogeny of conifers. Bot. Gaz. **23**: 40–43.

Coulter, J. M. & Land, W. J. G. 1905. Gametophytes and embryo of *Torreya taxifolia*. Bot. Gaz. **39**: 161–178.

Doyle, J. & Saxton, W. T. 1933. Contributions to the life-history of *Fitzroya*. Proc. Roy. Irish Acad. **41(B)**: 191–217.

Dupler, A. W. 1917. The gametophytes of *Taxus canadensis* Marsh. Bot. Gaz. **64**: 115–136.

————. 1920. Ovuliferous structures of *Taxus canadensis*. Bot. Gaz. **69**: 492–520.

Ferguson, M. C. 1904. Contributions to the knowledge of the life history of *Pinus* with special reference to sporogenesis, the development of the gametophytes and fertilization. Proc. Wash. Acad. **6**: 1–202.

Foster, A. S. 1943. Zonal structure and growth of the shoot apex in *Microcycas calocoma* (Miq.) A.DC. Am. Jour. Bot. **30**: 56–73.

Gottsche, K. M. 1845. Bemerkungen zur Inaugural-Dissertation: De *Macrozamia Preissii*. Auct. G. Heinzel. Bot. Zeit. **3**: 366–376, 377–385, 398–405, 413–419, 433–437, 447–454, 507–511.

Hofmeister, W. 1862. On the germination, development, and fructification of the higher cryptogamia and on the fructification of the coniferae. Transl. by F. Currey. Ray Soc. London.

Jäger, L. 1899. Beiträge zur Kenntniss der Endospermbildung und zur Embryologie von *Taxus baccata* L. Flora **86**: 241–288.

Juel, H. O. 1900. Beiträge zur Kenntniss der Tetradentheilung. Jahrb. Wiss. Bot. **35**: 626–659.

————. 1904. Über den Pollenschlauch von *Cupressus*. Flora **93**: 56–62.

Lawson, A. A. 1904a. The gametophytes, archegonia, fertilization and embryo of *Sequoia sempervirens*. Ann. Bot. **18**: 1–28.

————. 1904b. The gametophytes, fertilization and embryo of *Cryptomeria Japonica*. Ann. Bot. **18**: 417–444.

————. 1907. The gametophytes, fertilization and embryo of *Cephalotaxus drupacea*. Ann. Bot. **21**: 1–23.

Looby, W. J. & Doyle, J. 1939. The ovule, gametophytes, and proembryo in *Saxegothaea*. Proc. Roy. Dublin Soc. **22**: 95–117.

———— & ————. 1942. Formation of gynospore, female gametophyte, and archegonia in *Sequoia*. Proc. Roy. Dublin Soc. **23**: 35–54.

———— & ————. 1944. The gametophytes of *Podocarpus andinus*. Proc. Roy. Dublin Soc. **23**: 222–237.

Mathews, A. C. 1939. The morphological and cytological development of the sporophylls and seed of *Juniperus virginiana* L. Jour. Elisha Mitchell Soc. **55**: 7–62.

Miyake, K. 1910. The development of the gametophytes and embryogeny in *Cunninghamia sinensis*. Beih. Bot. Centr. **27**¹: 1–25.

Nichols, G. E. 1910. A morphological study of *Juniperus communis* var. *depressa*. Beih. Bot. Centr. **25**¹: 201–241.

Norén, C. O. 1907. Zur Entwicklungsgeschichte des *Juniperus communis*. Uppsala Univ. Årssk.

Ottley, A. M. 1909. The development of the gametophytes and fertilization in *Juniperus communis* and *Juniperus virginiana*. Bot. Gaz. **48**: 31–46.

Robertson, A. 1904a. Spore formation in *Torreya californica*. New Phytol. **3**: 133–148.

————. 1904b. Studies in the morphology of *Torreya californica*, Torrey. II. The sexual organs and fertilisation. New Phytol. **3**: 205–216.

————. 1907. The Taxoideae; a phylogenetic study. New Phytol. **6**: 92–102.

Sahni, B. 1920. On the structure and affinities of *Acmopyle Pancheri*, Pilger. Phil. Trans. Roy. Soc. B. **210**: 253–310.

————. 1921. Note on the presence of a 'tent-pole' in the seed of *Cephalotaxus pedunculata*. Ann. Bot. **35**: 297–298.

Saxton, W. T. 1910. Contributions to the life history of *Widdringtonia cupressoides*. Bot. Gaz. **50**: 31–48.

————. 1913a. Contributions to the life-history of *Actinostrobus pyramidalis*, Miq. Ann. Bot. **27**: 321–345.

————. 1913b. Contributions to the life-history of *Tetraclinis articulata*, Masters, with some notes on the phylogeny of the Cupressoïdeae and Callitroïdeae. Ann. Bot. **27**: 577–605.

————. 1934. Notes on conifers. VIII. The morphology of *Austrotaxus spicata* Compton. Ann. Bot. **48**: 411–427.

————. 1936. Notes on conifers. X. Some normal and abnormal structures in *Taxus baccata*. Ann. Bot. **50**: 519–522.

Schacht, H. 1850. Entwickelungs-Geschichte des Pflanzen-Embryon. J. C. A. Sulpke Amsterdam.

Sinnott, E. W. & Bloch, R. 1943. Development of the fibrous net in the fruit of various races of *Luffa cylindrica*. Bot. Gaz. **105**: 90–99.

Sokolowa, C. 1891. Naissance de l'endosperme dans le sac embryonnaire de quelques gymnospermes. Bull. Soc. Imp. Nat. Moscou II. **4**: 446–497. (1890.)

Strasburger, E. 1879. Die Angiospermen und die Gymnospermen. G. Fischer. Jena.

————. 1892. Ueber das Verhalten des Pollens und die Befruchtungs-Vorgänge bei den Gymnospermen. Hist. Beitr. **4**: 1–46.

————. 1904. Anlage des Embryosackes und Prothalliumbildung bei der Eibe nebst anschliessenden Erörterungen. Denks. Med.-Naturw. Ges. Jena **11**: 3–16.

Tahara, M. 1940. Embryogeny of *Torreya nucifera* S. et Z. Sci. Rep. Tôhoku Imp. Univ. IV. Biol. **15**: 419–426.

Thomson, R. B. 1905. The megaspore-membrane of the gymnosperms. Univ. Toronto Stud. Biol. **4**.

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CITATION OF BOTANICAL REFERENCES

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In 1893 the botanical congress assembled at Madison, Wisconsin, adopted "rules for citation," in the hope that they would become universal among botanists. This was an attempt to bring order into chaos. Measured by the criteria of simplicity and clarity, they are good rules and merit more general acceptance.[1]

If one examines the periodical literature of botany of the early years of this century, one finds the utmost heterogeneity in this matter of citation. Not only did one periodical differ from another, but even within the covers of one volume, of one issue, even in the "literature cited" on one page, there was no standard, no system. A recent writer[2] has expressed approval of this sort of thing by poking fun at modern editors who insist upon consistency. But I doubt whether the (anonymous) author would himself like to be seen in socks of different colors, though they would suit his purpose as well. And it is easy to show that heterogeneity of citation, besides conveying an appearance of slovenliness, actually invites error. The need for uniformity within one periodical in this respect is now generally recognized; the reasons are the same for general uniformity within the science. Such uniformity would be especially to the advantage of the taxonomist, who deals with a multiplicity of complex references, in which accuracy is vital to his peculiar concerns. Other varieties of botanists, however, would benefit almost as greatly; for it is of small use to adduce the facts and opinions of others in your work if you do not state concisely and accurately where that work is to be found. The purpose of the present note is to substantiate these contentions and to urge the general adoption of the Madison "rules for citation," with certain modifications which experience has shown to be desirable.

The diversity of which I am speaking is seen principally in methods of abbreviating (or not abbreviating) words, in the symbols used for series, volumes, parts, and pages, in the characters used for designating the numbers of the same, and in punctuation. Compare the following:

Quart. Journ. Micr. Sci., New Ser., vol. xxv, 1895.
Ann. of Bot., vol. x, 1896.
Ann. Sci. Nat., Bot., 9e sér. t. ix, 1909.
Bot. Zeit., vol. xxxix, 1881, pp. 329–336.
Prings. Jahrb. f. wiss. Bot., Bd. liv, 1915.

[1] They were printed in Bull. Torrey Club **22**: 130–132 (1895).
[2] See Am. Scientist 35[3].

These were all taken from one volume of one periodical. Notice that prepositions are sometimes included, sometimes omitted: "Ann. of Bot." but not "Ann. des Sci. Nat." Volumes are sometimes "vol.," sometimes "t." or "Bd.," more or less in accord with the country of origin, but not consistently so (compare the last two citations). A general rash of periods and commas probably betrays a deficiency of nourishing principles. With all the apparatus of citation, clumsy and untidy as it is, page numbers are given in only one of the above references. Here are some more, from various sources:

Compt. rend., 172, 99, pp. 1306–9, 1921.
Vidensk. Medd. Kjobnhavn, 1877, p. 736.
Ber. Botan. Gesellsch. vol. xxvi. p. 468.
Jourd. & Fourr. Icon. Fl. Eur. i. 6. iv. fig. 13 (1866).
Rabh. Krypt.-Fl. Deutschl. ix. iv. I. 145 (1933).
Ann. d. Chem., t. CCCLXXXVI.
Gard. Chron. Ser. III., LXXXVII. 431 (1925).
Fl. lusit. et. brasil. spec. (1788) 1 t. 1 f. 1.
Jacq. Ic. i. 2. t. 13.
Sol. 1. c. lii. 654, 6. 20 (1762).
Rec. d. trav. bot. néerl. 29, S. 497, 1932.
C. R. Ac. des. Sc. T. 211, 1940, p. 359.
Cbl. f. Bakt. I, 24: 11–12.
Bot. Mag. LXXXVIII (1862) t. 5339.

It is evident, first, that most of the commas and many of the periods have nothing to do in these citations. Punctuation is like government, the less you have the better off you are, providing you have enough to maintain order.[3] The period that serves as a sign of abbreviation ("Sci.") can also separate the words, and no comma is necessary before the following word or number. To those who use the Madison rules the citation "Ann. Sci. Nat. Bot. IX. **9**" is clear and concise.[4] Such a citation, provided that all are using the same code, needs no "v." or "vol." or "t." or any other encumbrance to make it clear that the following number is that of a volume; the same applies to "ser." and to "pp." and the like. These symbols have, indeed, largely become obsolete; but without general agreement confusion may result. Notice the fifth citation in the last group above; could any one go at once to the shelf and reach down the right volume of this work? In short, that brevity which is the soul of accuracy depends upon uniformity. The Madison rules provide that the series (if any) be designated by Roman capitals followed by a period, the volume by an Arabic numeral in boldface type, and the part (if it is necessary to cite it because of independent paging)

[3] The same principle holds good for references in an article to a "literature list" at the end: in a review of literature "(Smith 1948)" needs no comma between author and date.

[4] The word "Bot." (for "Botanique") can also be omitted in an exclusively botanical work.

by an index (superscript) number. The number of the volume is followed by a colon, and this in turn by the numbers of the pages.

The dangers of Roman numerals used freely are evident, especially in "lower case"; a certain reference to "v. 16" long eluded me because I thought it meant "volume 16" instead of "volume 5 page 16." "ic." and "l.c." are easily misread. The eight Roman capitals of the last citation above offer that many chances for error as compared with the two of "**88**"; perhaps we should be grateful that the plate number which follows was not similarly designated.

The symbols for designation of illustrations are a special problem; here one must use some device to make it clear that the numbers do *not* refer to pages. There is a wide choice of available signs: Pl., pl., Taf., Tab., t., fig., f., text-fig., Textabb. "t." is easily confused with "tome" (notice the sixth citation in the second group above). "Taf." and "Tab." are used also for "tables." "Text-fig." refers to a distinction no longer so familiar as formerly because of changes in methods of production. The "*pl.*" and "*f.*" prescribed by the Madison rules are as simple as any, and probably generally understandable; the most valuable feature is the use of italic in citing illustrations, which at once differentiates them from the rest of the citation.

As for abbreviations, the principles laid down (and not always followed) in the *International rules of botanical nomenclature*, ed. 3, Rec. XXX, for the abbreviation of authors' names serve admirably for the abbreviation of titles also. The reader of the present note can easily select from the examples given words and titles which are unnecessarily long ("Gesellsch." where "Ges." is sufficient) and those which are unduly abbreviated ("Cbl." for Centralblatt. Uniform capitalization makes for easier reading. Prepositions are usually unnecessary ("d.", "f.", "of" in the examples). Since a brief discussion of abbreviation has been published elsewhere,[5] it need not occupy space here.

While it is perhaps undesirable and probably impossible to promulgate and adopt an index of all abbreviations of authors' names and of titles,[6] it would not be difficult to establish, in one of the larger botanical libraries, a central bibliographic clearing-house where the *International rules* might be edited for uniformity of citation. Without great expense a catalogue could be formed of all authors and titles cited, new titles being added as they occurred in successive editions; by reference to this, citation of authors' names and of titles could be made and kept uniform. All references, moreover, could readily be compared with the original sources, and accuracy

[5] Bull. Torrey Club **74**: 348. 1947.

[6] Such an index was proposed at the Madison Congress; see Proc. Madison Bot. Cong. 45 (1894).

would be gained at the same time as consistency. In one list of names printed in the present *Rules* a well known work is referred to as "L. Spec. pl."; in another it is "L. Sp. Pl." Among the rejected names for genus 4090 we read "Chalcas L., Mant. I (1767) 68" and "Bergera Koenig ex Linné, Mant. II. (1771) 555"; this is all one work, continuously paged; the Roman numerals are superfluous; and, as far as I know, all is by the same Linnaeus. "Periloba Rafin.," "Toxylon Raf.," "Adlumia Rafin.," and "Quamasia Raf." were all described by the same man. *Pentagonia* Benth. has been proposed for conservation against *Pentagonia* "Heist. ex Fabricius, Enum. Pl. Helmstad." This is presumably the same work as "Fabr., Enum. pl. Hort. helmstad" and "Fabricius, Enum. Pl. Hort. Helmst." of the *Rules*. Such diversity has arisen obviously through the contribution of proposals from many sources; this is one argument the more for the necessity of proper editing in a permanent headquarters. The abbreviation "Schlecht." or perhaps "Schlechtend." is preferable to "Schlechtd.," not to mention "Schltd."; and "Hpe." is certainly not a clear abbreviation, even if perhaps it has been in "general" use. On the other hand, Engler and Prantl certainly need not be spelled out, and might well be abbreviated (as in many American works) "E. & P.," being almost as well known as Linnaeus. Torrey and Gray are sufficiently clearly indicated by the now customary "T. & G." instead of by "Torr. et Gray" and the several other versions found in current lists of nomina conservanda. In general, such lack of system should not be permitted in a document pretending to be an instrument of clarity and precision. Nor is this only a matter of appearances. In referring to two volumes of the *American monthly magazine* the years are used instead of volume numbers: 1817 and 1818. But volume 1 and part of 2 appeared in 1817, the rest of 2, 3, and part of 4 in 1818; for the first citation one must look in two volumes, and for the second in three—only to find that the name in question appeared in 1819. This name is given as "Joxylon Raf.," though it was printed "Ioxylon" in the first reference and corrected to "Toxylon" ("bow-wood," a common local name) in the second. All this comedy of errors could have been avoided by such a procedure as I have outlined.

To measure the acceptance of the Madison rules, a survey of 32 periodicals in five languages was made with reference to the numerals used for volume numbers. The results were as follows:

	Roman		Arabic		No consistent
	lower case	capital	boldface	plain	practice
U.S.A.	1	...	5	2	1
German	...	1	7	..	1
French	..	1	1	...	2
English	4	3	2	...	...
Swedish	...	...	...	...	1
	5	5	15	2	5

The trend towards the Madison rules was measured by comparing older and more recent issues of the same periodicals; these had changed from Roman numerals to Arabic boldface as follows: 1 in U. S. A, 3 in Germany, 2 in France, 1 in England; none had made the reverse change. It is clear that the advocates of the older system have only an irrational conservatism to advance in the face of general practice.

In conclusion, it is obviously desirable (as it was in 1893) to adopt a uniform system for botanical references, and that formulated at Madison has been fairly generally used and has stood the test of time. It should be given international authority by re-enaction by the next Congress. Some modifications, however, seem desirable.

(1) The use of brackets for certain particulars—as in "[6th ed.]"—may be unnecessary. The edition number is to be treated as a part of the title. The word "*illust.*" is equivalent to any other statement of illustrations, and should be so treated.

(2) It may be well to designate, at least sometimes, parts of a volume by numbers in parentheses instead of by superscript numbers. This has an advantage for volumes which are subdivided more than once—having parts within parts.

(3) The place of the date need not be rigidly specified, and it may be desirable in some references to enclose the date within parentheses so as not to disturb the continuity of a sentence. Citation of the year of publication is one of the few things that offer no difficulty; no one seems to have found it worth while to disguise it. Citation of day and month should conform to the method prescribed by the Madison rules.

(4) The distinction between volumes and other divisions of a series, to be signalized by the use of boldface or plain type respectively, is questionable. There is no available definition of what constitutes a volume. It may mean a principal division of the work irrespective of pagination or of physical composition; it may refer simply to binding ("Band"). Michaux' *Flora boreali-americana* consists of two "tomes" paged separately but often bound together: two volumes in one sense, one in the other. De Candolle's *Flore française* has five "tomes" but six "volumes," the fourth "tome" being divided into two "parties" and the sixth volume being designated as "tome cinquième, ou sixième volume." *Das Pflanzenreich* has a dual system. It was issued in "Hefte" which were not numbered in taxonomic order; the whole series was numbered also in four parts, and the families numbered within the parts. The main parts of this work may be said to correspond, for practical purposes, to the volumes of other serial publications, being the primary divisions; the separate issues ("Hefte") need not be cited, and, indeed, cannot be unless their covers were saved. *Heft 23* may best be cited, for instance, as $\mathbf{4}^{225}$. *Tropical woods* is issued in parts, with no indication

of larger units; for such parts the boldface numeral seems appropriate and useful. On the other hand many "bulletins," though consecutively numbered, are gathered into volumes, and the numbers of the latter must obviously be treated as primary.

In general, the changes I suggest are such as to render the rules less strict and therefore easier to apply. Consistency and clarity can be attained even more certainly by modification in this direction. The authorization of a greater degree of freedom in the application of the rules is not to be interpreted as a return to irresponsibility (once established for any particular work, usage should be followed with precision), but as recognition of the part that intelligence should play in the use of any rules.

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CITATION OF AUTHORS' NAMES IN TAXONOMY

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In the *International rules of botanical nomenclature*, ed. 3, under the general heading "Citation of authors' names for purposes of precision," we find the following article.

> Art. 48. When a name of a taxonomic group has been proposed but not published by one author, and is subsequently published and ascribed to him (or her) by another author who supplied the description, the name of the latter author must be appended to the citation with the connecting word *ex*. The same holds for names of garden origin cited as "Hort."
>
> If it is desirable or necessary to abbreviate such a citation, the name of the publishing author, being the most important, must be retained.
>
> Where a name and description by one author are published by another author, the word *apud* is used to connect the names of the two authors, except where the name of the second author forms part of the title of a book or periodical, in which case the connecting word *in* is used instead.

To attempt to make such distinctions between citations, by using different prepositions, may be to adduce information for which we have no evidence. When a name is published by Torrey and Gray and by them ascribed to Nuttall, it is often impossible to say whether the latter supplied the name and description or the name only. The difficulty in applying this provision is well seen in two citations which occur within a few lines in the list of nomina conservanda: "*Nomochloa* Beauv. ex Lestib. Ess. Fam. Cypérac. (1819) . . ." and "*Heleophylax* Beauv. in Lestiboudois, Essai fam. Cypér. (1819). . . ." In one line it is stated that Beauvois proposed the name *Nomochloa* and that Lestiboudois supplied the description; in the other that he furnished both name and description of *Heleophylax*. In spite of the diversity of abbreviations, both citations are from the same work, and no evidence for such a distinction appears in this work.

As an example to illustrate the use of *in* the following is given: "*Viburnum ternatum* Rehder (in Sargent, Trees and Shrubs, II . . .) . . . in this latter example the second author's name, Sargent, forms part of the title of a book." This is manifestly incorrect. On the title-page of the book in question we read: "Trees and shrubs. Illustrations of new or little known ligneous plants. . . . Edited by Charles Sprague Sargent." The name of the "editor" certainly forms no part of the "title." What was presumably meant was that it is necessary to use Sargent's name in specifying the work; one cannot refer to "Trees and shrubs" as one can to "Botanical Gazette," simply by volume and page. Here a certain confusion enters. Is the name of the editor or author of the work cited as being one of the "authorities" of the name published therein? Or is his name inserted merely as a bibliographic con-

venience, a means of specifying the work? So it may be necessary to use the name of the editor in referring to a periodical; e.g., Hooker's *Icones plantarum,* Desvaux' *Journal de botanique,* to distinguish these from other *Icones plantarum,* other *Journaux de botanique.* But in such cases the editor's name is merely a conventional symbol, one among the several used in specifying a certain periodical, and he is not regarded as responsible for names published in its pages. Engler's name was formerly generally prefixed to the *Botanische Jahrbücher* which he founded and for many years edited; this is actually no more necessary than it is to use Coulter's name in referring to the *Botanical gazette.* Are we to insert the preposition *in* if Engler's or Coulter's name is used in designating the periodical, and omit it otherwise? Such a procedure adds complexity without any possible gain to our citations. It would be as useful and appropriate to cite the name of all editors of botanical periodicals for the names which appear under their supervision.

The intent of the article is certainly that the "second author" is really the author of the pages in question, who provides space otherwise occupied by his own writing to the name and description furnished by another. To signalize this relationship by means of a special preposition is of doubtful usefulness. Furthermore, due regard should be shown for known facts in joining the names of authors. It is unnecessary to ascribe *Securigera* to "DC. in: Lamarck et De Candolle, Fl. Franç. ed. 3 . . ." since it is well known that de Candolle was the author of this edition and the work is sufficiently identified as "DC. Fl. Fr." Again, new names which appeared in Sowerby's *English botany* are ascribed to J. E. Smith, the author of the text. Instead of writing "Smith in: Sowerby, Engl. Bot." it is conducive to clarity and to economy of space to write simply "Smith, Engl. Bot." Perhaps the reductio ad absurdum of botanical citation is seen in such examples as "*Andreoskia* DC. in DC. Prodr. I (1824) 190." It is obvious that here only one author is cited (as was true also in the previous examples), and no preposition is necessary to connect his name with itself.

To sum up: It is frequently impossible to determine which of the prepositions *ex, apud* or *in* should be used as prescribed in Art. 48. When an author's and particularly an editor's name is used merely to identify a work of periodical, the use of a special preposition is meaningless; methods of citation, having regard to clarity and brevity, shouly follow the same principles for such works and periodicals as for others. Redundant citation of "authorities" that are not so in fact should be avoided.

The second paragraph of the article is never followed. If a writer does not cite "*Peucedanum salmoniflorum* Coult. & Rose ex Holzinger;" he writes simply "*Peucedanum salmoniflorum* Coult. & Rose," and that is literally the end of it. It is of no use to write provisions into the *Rules* that cannot be

enforced, however desirable in theory. The point is that citation of authorities in itself is of small bibliographic importance, since it carries no information on the place of publication. It does add "precision," so that we need not confuse *Benthamia* Richard with *Benthamia* Lindley; besides giving that credit for taxonomic discovery which is dear to the hearts of its practitioners.

In conformity with the foregoing conclusions, Article 48 should be changed to read as follows:

Art. 48. When a name of a taxonomic group has been proposed but not published by one author, and is subsequently validly published and ascribed to him by a second author, the names of both authors should be cited. The same holds for names of garden origin cited as "Hort."

A semicolon may be placed between the names of the two authors; or a preposition may be used instead to convey more definite information on their relative contributions. For this purpose *ex* indicates that the second author supplied the description associated with the name proposed by the first author; *in* should be used only if an author (or editor) whose name appears on the title page of a book includes in his pages names and descriptions of another author, properly ascribed to the latter; *apud* may be used for a similar relationship when publication is effected in an article in a periodical.

Examples: *Centropogon coccineus* Regel ex F. E. Wimmer, Ann. Naturh. Mus. Wien **46**: 421. *Lobelia pectinata* Engelm.; Wisliz. Tour N. Mex. 108. *Sium pusillum* Nutt.; T. & G. Fl. N. Am. **1**: 611. *Teucrium charidemi* Sandwith apud Lacaita, Cavanillesia **3**: 38. *Viburnum ternatum* Rehder in Sargent, Trees & Shrubs **2**: 37.

Recommendation XXXII quater, adopted at the Congress in Amsterdam in 1935, still further complicates procedure. It reads: "In citation of literature 'in' should be inserted after the name of the author if the citation refers to a periodical or other serial publication, or if it is a work by another author." The second part of this merely duplicates part of Art. 48, in providing for the insertion of *in* before the name of the "second author"; in fact, one of the examples adduced for the Recommendation is actually drawn from the same work as that used to exemplify the Article, Sargent's *Trees and shrubs*. As for the first part of the Recommendation, in providing for the general use of "in" in all citation of periodical literature, it renders meaningless most attempts to conform to the Article. When we write "*Cyathea cunnighami* Hook f. in Hook. Ic. **54**: *pl. 985*," do we insert the preposition because the name was "published" by W. J. Hooker for J. D. Hooker, who furnished the description, the elder Hooker's name being "part of the title" of the periodical; or simply because it appeared in a periodical? Obviously, if we are to use *in* for *all* references to periodicals, it is silly to specify its use for *certain* periodicals. Actually to adopt this Recommendation would be to add unnecessary complexity without gain. The Recommendation (now in its period of probation) should be rejected at the next Congress.

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SOME NEW OR INTERESTING FUNGI

M. J. THIRUMALACHAR

An Undescribed Leaf Parasite of Cycas. *Cycas circinalis* and *C. revoluta* are commonly planted in the gardens in South India for their foliage. In the months from September to February, a leaf disease caused by a species of *Arthrobotryum* was noticed in many places. The infection spots appear as irregular orange-yellow specks on the dorsal surface of the leaf. On the lower surface sooty-black spots are formed by the aggregation of a number of coremia. The mycelium is intercellular and slightly dark in color. The synnema is formed by the closely interwoven mass of hyphae emerging from the stoma. The entire synnema is obconical and bears on the apical half numerous conidiophores, on which 3–4-celled conidia are borne acrogenously. The mature spores are 3–4-celled, yellowish-brown, cylindric, rounded at both ends, slightly constricted at the septa and measure 25–31 × 7.5 × 12 μ. The epispore is minutely and closely warty. The present species is distinct from other species of *Arthrobotryum* recorded on other phanerogamic hosts as well as parasites on *Meliola*.

Arthrobotryum Cycadicola Thirumalachar, sp. nov. Infectionis maculae luteae, irregulares, 2–4 mm. diam. Synnemata hypophylla, nigra, 70–100 μ alta, 40–71 μ lata ad basim 144–180 μ lata ad apicem et consequenter obconica. Conidiophori simplices, clavati; conidiis terminalibus, conidia cylindrica, luteo-brunnea, fuliginosa si plura aggregentur, rotunda in utroque apice, 2–4-septata, constricta ad septa, magnitudinis 25–31 × 7.5–12 μ; episporio dense operto minutis atque obtusis verrucis.

Infection spots yellow, irregular, 2–4 mm. in diam. Synnemata hypophyllous, black, 70–100 μ high, 40–71 μ wide at the base and 144–180 μ at the apex and thus being obconical. Conidiophores simple, clavate with terminal conidia; conidia cylindric, yellowish-brown with a sooty appearance in mass, rounded at both ends, 2 to 4-septate, constricted at the septa and measuring 25–31 × 7.5–12 μ, epispore densely covered with minute and blunt warts.

Hab. on the pinnae of *Cycas circinalis* L, leg. M. J. Thirumalachar, Bangalore, South India, 24–10–1945 (TYPE). Type deposited in the Herb. Crypt. Ind. Orient., New Delhi, India, and in the Herbarium, I.M.I., Kew, England.

SEPTORIA CYNODONTIS Fuckel. Symb. Myc. 389. Sacc. Syll. Fung. **3**: 562. On the leaves and sheaths of *Cynodon dactylon* Pers. Bangalore, India, 13–10–1945.

The infection appears as long, thin striae on the upper surface of the leaves.

SEPTORIA SWERTIAE Pat. Rev. Mycol. 181. 1886; Sacc. Syll. Fung. **10**: 376. A *Septoria* species was collected near Kemmangundi, Mysore State (India), on the leaves of *Swertia* sp. which agreed very well with *Septoria*

Swertiae described by Patouillard from material collected in China. The infection spots were epiphyllous, brownish-black, bearing numerous pycnidia. The mature pycnidia are 57–71 μ in diam. with numerous hyaline, acicular 1-septate spores. Rarely some of the spores are 2-septate.

During a study of the pycnidia, the association of the perithecia of a *Leptosphaeria* was noticed in numerous cases. These were produced from the same mycelium which bear the pycnidia, and it became evident that the two belong to the same fungus. Since *Septoria Swertiae* is not known in its perfect stage and the type material is not available for comparison, it is not possible to determine whether the *Leptosphaeria* stage observed in the present study would constitute the perithecial stage of Patouillard's fungus. Since no similar species of *Leptosphaeria* has been reported on species of *Swertia*, the name **Leptosphaeria Swertiae** is tentatively proposed for the accommodation of the fungus.

The perithecia are epiphyllous, closely associated with the pycnidia, flask-shaped, yellowish-black, subepidermal, erumpent, and ostiolate. Asci cylindric, 42–46 × 7–11.5 μ, paraphysate, paraphyses simple and filiform, about the same length as the asci, 8-spored; ascospores, 1–2–seriate, cinnamon-yellow, fusoid, 6–7–septate, not constricted at the septa and measuring 16–20 × 4–4.5 μ.

On the leaves of *Swertia* sp. Kemmangundi, leg. H. C. Govindu, 12–8–1945. (S. India.)

PHYLLOSTICTA on *Epichloe cinerea* Berk. & Br. *Epichloe cinerea* Berk & Br. in a common parasite on the inflorescences of *Eragrostis pilosa* Beauv. round about Bangalore (S. India). As a result of infection the inflorescence becomes transformed into a clavate to cylindric stroma 4–5" long with numerous perithecia embedded in it. A species of *Phyllosticta* was found growing on these stroma in large numbers. The hyphae appeared to penetrate into the stromatic tissue and the ostioles were occluded by the mycelial strands of the *Phyllosticta*. Many of the perithecia were without asci and ascospores. Some of these observations indicated that the *Phyllosticta* sp. might be parasitic but more evidences are required to confirm the parasitic behaviour. *Ägerita Pezizoides* (Cda) Bon. and *Botrytis Epichloes* Ell. & Dearn. have been recorded in literature as being hyperparasitic on the stroma of *Epichloe*. The *Phyllosticta* species noticed was exclusively confined to the stroma without attacking *Eragrostis*. As no other species of *Phyllosticta* has been recorded on *Epichloe* or related forms the present one is proposed as a new species.

Phyllosticta Epichloes Thirumalachar, sp. nov. Pycnidia globosa, superficialia, hyphis intertexis, ostiolata, 37–55 × 37–70 μ, nigra. Sporae ovatae, hyalinae, 4–5.5 × 2.5 μ. Conidiophori simplices, breves, erecti atque hyalini.

Pycnidia globose, superficial with interwoven hyphae, ostiolate, 37–55 × 37–70 μ, black. Spores ovate, hyaline, 4–5.5 × 2.5 μ. Conidiophores simple, short, erect, and hyaline.

On the stroma of *Epichloe cinerea* Berk & Br., leg. M. J. Thirumalachar, Bangalore, 18–11–1944, TYPE, deposited in Herb. Crypt. Ind. Orient., New Delhi, and in Herb. I.M.I., Kew, England.

GLOESPORIUM PALMARUM Oud. Contr. Myc. Pays-bas. **14**: 48. Sacc. Syll. Fung. 11: 567.

On young leaves of *Areca catechu* L., Mysore, S. India, leg. M. J. Thirumalachar, 4–4–1945. The fungus also causes sometimes lesions on young nuts and portions of the inflorescence. The acervuli are numerous with one-celled spores which measure 17–20 × 5-6 μ. It agrees well with the descriptions of *Gloeosporium palmarum* Oud. on *Areca sapida*. A *Gloeosporium* sp. has been recorded by Thomas (Administr. Rep. Gov. Mycol. Madras, **1936–37**. pp. 17) for South India.

A Cylindrosporium Leaf Blotch of Curry Leaf. *Murraya Koenigii* Spr., popularly known as the curry leaf tree is widely grown in S. India for its leaves which are used for culinary purposes. A leaf blotch disease incited by a species of *Cylindrosporium* has been found to do some damage. The blemishes deteriorate the quality and reduce the market value of the leaves.

The acervuli of the fungus are epiphyllous, subepidermal, and erumpent, producing numerous acicular conidia in mass. Mature conidia are hyaline multiseptate and measure 50–80 × 3.5–6 μ.

Cylindrosporium Koenigii Thirumalachar, sp. nov. Infectionis maculae albidae, epiphyllae, circulares vel irregulares, 3–10 mm. diam. tenuiter elevatae, anthracis maculis similes; acervuli subepidermales, erumpentes, confluentes atque continui evadentes; conidiophori clavati, cylindraci, hyalini, simplies, 44–56 × 3.5–4.5 μ, acrogene producentes conidia, fusiformia; conidia hyalina, multiseptata, attenuata in apice, haud constricta ad septa, magnitudinis 50–80 × 3.5–6 μ.

Infection spots whitish, epiphyllous, circular to irregular, 3 to 10 mm. diam., slightly raised and appearing as anthracnose patches; acervulus subepidermal, erumpent, confluent and becoming continuous; conidiophores clavate cylindric, hyaline, simple, 44–56 × 3.5–4.5 μ, developing acrogenously acicular to fusiform conidia; conidia hyaline, multiseptate, tapering at the apex, not constricted at the septa, and measuring 50–80 × 3.5–6 μ.

On the leaves of *Murraya Koenigii* Spr., leg. M. J. Thirumalachar, Bangalore (S. India) 12–3–1945. TYPE deposited in the Herb. Crypt. Ind. Orient; New Delhi, and in Herb. I.M.I., Kew, England.

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SALIX PETIOLARIS J. E. SMITH: AMERICAN, NOT BRITISH

CARLETON R. BALL

At the very end of his review of "Difficulties in North American *Salix*," Dr. M. L. Fernald (8, p. 46–48) discusses *Salix petiolaris* and makes some amazing statements. On page 47, he says: "It seems extraordinary that the identity of our low shrub, *Salix gracilis*, should, for more than a century and a quarter, have been confused by all students of *Salix* with the British tree, *S. petiolaris* J. E. Smith, Trans. Linn. Soc. vi. 122 (1802), Engl. Bot. xvi. t. 1147 (1803), and Fl. Britt. iii. 1048 (1804), etc." On page 48, he concludes: "The latter name [*S. petiolaris*] seems to have been wholly misapplied to our material."

It would have been extraordinary if it had been true. In these statements, however, Fernald offers no definite evidence, but merely a dogmatic conclusion. Therein he tells all American botanists beginning with Pursh (17) in 1814, and all British botanists later than Hooker (12) in 1820, Forbes (10) in 1829, and Loudon (15) in 1838, that they did not know what they were talking about when they denied that *Salix petiolaris* ever was a native British willow. At the outset of this discussion let it be stated emphatically that *S. petiolaris* J. E. Smith was wholly an American plant when published in England in 1802 and still is after 145 years. Now for the evidence, point by point.

Point 1. The Assertion that S. petiolaris is "British." *Salix petiolaris* was described by Sir James Edward Smith (20, p. 122–123) in 1802. His description and notes follow:

"Salix petiolaris. Dark long-leaved willow.

"S. foliis lanceolatis serratis glabris subtus glaucis, germinibus pedicellatis ovatis sericeis, stigmatibus sessilibus bilobis.

"In salicetis et palustribus. D. Dickson. Fl. Aprili.

"This species has not been found wild in Norfolk, but was sent to Mr. Crowe by Mr. Dickson, along with the last [*S. laurina*], as of British growth. It has most affinity with the two preceding species [*S. laurina* and *S. nigricans*] but has longer and more slender twigs. The leaves are 4 or 5 inches long, about an inch broad, lanceolate, pointed, serrated, somewhat revolute, generally a little unequal at the base; bright green, smooth and shining above; glaucous beneath, and sometimes a little hairy. In drying they turn of a purplish black. The footstalks are peculiarly long, linear, and slender, silky on the upper side. Stipules small, crescent-shaped, toothed, smooth. The female catkins, the only sex I have seen, are scarcely an inch long, with black, hairy, often obovate, often notched, scales. Germens on long footstalks, small, ovate, silky. Stigmas perfectly sessile, ovate, obtuse, divided into two lobes."

Smith described it again, with a colored plate, in 1803. The branches now are included, as "slender, flexible, round, smooth, more or less purplish or

brown" (21, species & plate 1147). As to source, Smith says: "For this new species of *Salix* we are obliged to Mr. Dickson, who found it in some part of Great Britain, the exact place is not remembered, and sent it in a growing state to Mr. Crowe. We know only the female, which is a small spreading tree." It was described again, in Latin (22, p. 1048–49) in 1804.

In his final publication (23, p. 181–182), in 1828, Smith says: "In osier grounds and swamps. Sent from Scotland by the late Mr. Dickson. In Possil marsh, on the north side of the canal, Mr. David Don. Marshes in Angus-shire, Mr. George Don. *Hooker*." He then refers to Pursh's doubt of British origin but does not see why it should not be wild in Europe as well as in North America.

Hooker (12, p. 419), in 1820, refers to the Scottish localities and states: "I have never seen native specimens," which he repeats essentially in later editions. In ed. 6 (p. 386. 1850) he says: "Not uncommon in North America and certainly not a European species, although perhaps as wild in this country as most of our other tree willows." Forbes (10, p. 45) discusses it in 1829. Loudon (15, p. 1533–34), in 1838, reviews previous literature and quotes extensively, but finds no further evidence of British origin.

S. petiolaris has never been included in British floras since these early authors. When revising and monographing the British willows, White (25) in 1890 and Linton (14) in 1913 did not think it necessary to mention it even as an excluded species.

In America, Pursh (17, p. 616), in 1814, follows Smith's description but says: "It has been by mistake adopted as a native of Great Britain." He described also *S. fuscata* Ph. (p. 612) from New York and Pennsylvania, which generally has been considered synonymous with *S. petiolaris* but which, by its obovate-lanceolate leaves, obtuse scales, short-pedicelled capsules, and black-tomentose 1-year twigs, probably is *S. humilis* Marsh., or possibly *S. discolor* var. *latifolia* Andersson.

Hooker (13, p. 148), in 1839, includes *S. petiolaris,* with leaves serrate, from "Lake Winnipeg. Dr. Richardson." Also "*S. rosmarinifolia* L.," with leaves narrow and mostly entire, from "Saskatchewan. Dr. Richardson." This latter is not Linné's species but the later-described *S. gracilis* Andersson. Barratt (7, p. 4), in 1840, says: "This is undoubtedly a native Willow, since both sexes are found here plentifully. The staminate plant was unknown in Great Britain till transmitted by me, in the living state."

Torrey (24, p. 207), in 1843, says: "This species was many years ago adopted by mistake as a native of Scotland, and has ever since obtained a place in British floras, but there can be little doubt that the plant described by Sir J. E. Smith was of North American origin, as Pursh and Lindley have both asserted." All later publications, from Gray's Manual (11, p. 426) in 1848 onward, have recognized *S. petiolaris* as an American species, until Fernald's statement in 1946.

Fernald (8, p. 48) says: "Although Schneider talked all around the subject, . . . , there is no indication in his discussion that he actually compared our species with true *S. petiolaris.*" As "our species" is the true *S. petiolaris,* this criticism falls. But Schneider (19, p. 16–19, not '16–24' as Fernald says) reviews more literature than is discussed herein and quotes the opinions of numerous British and American botanists. He then observes: "How this plant came to England has never been exactly explained."

That *S. petiolaris,* and many other American plants, did reach Great Britain in early days is not surprising. Their tradesmen were on the lookout for material to use in their hand industries, of which basketry was an important member. Their private botanic gardens were constantly obtaining foreign material. Smith himself says (20) that "Mr. Crowe . . . for many years . . . has . . . collected willows, both indigenous and exotic, from all quarters . . ." The occurrence of this American willow as an escape in waste places in Scotland undoubtedly resulted from throwing the twig clippings from basket making into such spots, as has happened in America.

Point 2. Assertion that S. petiolaris is a "tree"; S. gracilis a "low shrub." Fernald says (8, p. 47) "the British tree, *S. petiolaris* J. E. Smith." as contrasted with "our low shrub, *S. gracilis.*" Smith originally did not give the height but in 1803 (21) he says: "We only know the female, which is a small, spreading tree." Forbes (10, p. 45), in 1829, called it "A bushy tree, with slender, spreading . . . branches."

All the British descriptions were drawn from cultivated plants in private botanic gardens. In such gardens, in Britain, the soil was enriched and the plants usually well spaced, with little competition. These conditions stimulate growth to unusually large size. Further, all of the British plants were from cuttings, which insures a single stem and therefore a tree-like habit of growth. As all of the nutrients go to develop a single stem, rather than a clump of stems, this insures increased height. Finally, all of the British plants were female and, being unfertilized, used no nutrient energy in ripening an annual seed crop. No actual heights are given by British authors.

American descriptions, on the other hand, were based on wild plants growing in natural conditions of soil, exposure, and competition. Most of the earlier observations also were made in the extreme southern portion of the range of *S. petiolaris,* where climatic conditions are least favorable to its development. In 1814, Pursh (17, p. 616) follows Smith's description. In 1840, Barratt (7, p. 4) does not record the height. In 1843, Torrey (24, p. 207) says: "stems 4–10 ft. high." In 1865, Wood (26, p. 653) says: "Shrub or small tree 4–15 ft. high," but does not give the source of his information.

Salix petiolaris shows its lowest average height in the southern portion of its range, from New England to Nebraska. Northward, its height steadily increases. In central Saskatchewan and central Alberta, heights of 8, 10,

and 12 feet are recorded commonly. The writer found plants 10–12 feet high (No. 2358) at Clyde, north of Edmonton. Even in extreme northern Alberta (lat. 59° 30′), *Raup 2125* was from a "shrub about 10 ft high." On request, Dr. George H. Turner is measuring heights and studying habit in the Edmonton area. Already, he has found many plants 12–14 feet high, some 15 feet, and one each 17.5, 19.5, and 22 feet in height. His full paper will appear in a Canadian journal.

Several of the writer's plants in the Clyde area were few-stemmed and tree-like in habit, with more or less spreading branches. Dr. Turner already has found several single-stemmed plants in open aspen woods. Some are young and only 4–8 feet high. Others are 11 feet high. All are tree-like in habit, with somewhat spreading branches. He also finds few-stemmed plants 12–14 feet high and tree-like in habit. These taller plants are not "low shrubs," and where they have but one or few stems they are "small trees." Fernald himself says (8, p. 46) that "*S. gracilis* is a slender shrub . . . 1–3 m. high." Now, 3 m. is 10 feet, which is not exactly low for a shrub. The contention for a specific difference in height and habit appears to be unproved.

Fernald further says (8, p. 46): "Typical *Salix gracilis* is smaller and generally more northern" [than his var. *textoris*, which is true *S. petiolaris*]. The 12–22-foot northern plants therefore should be smaller than those farther south. Exactly the reverse is shown to be true.

Point 3. Assertion of Spreading Branches on "British," Erect on American Plant. Fernald states (8, p. 47) that *S. gracilis* of America "is a slender shrub with erect, green to olive-brown tenuous and flexible branches." He further states, quoting Forbes (10, p. 45) with bracketed comments of his own, that the alleged "British" *S. petiolaris* is "a bushy tree, with slender, spreading [not strongly ascending] purplish or dark-brown [not green or olivaceous] branches." The tree-like habit of British-grown plants has been explained above, under Point 2. They were single-stemmed because grown from cuttings, and they were "bushy" because grown widely-spaced in botanic gardens.

With little competition from neighboring plants, or among the few stems of one plant, the branches tend to grow outward. With severe competition from adjacent plants, or among crowded stems of one plant, they necessarily must grow upward. The low, clumpy, many-stemmed plants in northern United States and northward have erect or ascending stems and branches. The fairly common taller plants of more northern Canada, when they have few stems, have more or less spreading branches. Both types of branching, and all degrees of intermediacy, may be seen in some Canadian localities. These differences are environmental and not genetic effects.

Point 4. Statement that S. petiolaris has Purplish; S. gracilis Greenish Twigs. This statement is quoted in Point 3, above. The only answer is that both so-called species have twigs with both ranges of color. Some 275 sheets of *S. petiolaris* in the writer's herbarium, collected from New England westward to Nebraska and Colorado and northward far into Canada, have been examined. Practically all of them show something of the two color ranges but the dominant effect is brown to dark brown rather than green to light brown.

In general, the 3- and 2-year twigs are brown to blackish, especially in summer and autumn. One-year and seasonal twigs often are green to olive-green to yellow, especially early in the season. These differences are noted on the same plant. In general, there is a progressive deepening of the color on all twigs as the season advances. All these facts were especially evident where collections had been made from the same plant at intervals during the season. This has been done by A. J. Breitung, the late A. H. Brinkman, W. C. McCalla, and G. H. Turner in Canada, and F. W. Rapp in Michigan. The average twig color tends to be lighter in the drier Great Plains area than in the more humid eastern areas. Specimens from Nebraska and Colorado, and many from Alberta, show distinctly reddish twigs, which McCalla says are beautifully crimson in spring.

Bebb 24, grown by him from cuttings received from Kew Gardens, England, also shows twigs ranging from greenish to dark brown. Evidently there is no specific difference in twig color between *S. petiolaris* and *S. gracilis*, whatever their relationship.

Point 5. Claim that Only the "British" Plant has Leaves 4–5 Inches Long. The original description of *S. petiolaris* (20, p. 122) says: "The leaves are 4 or 5 inches long and about an inch broad." In 1803, Smith said (21, No. 1147): "Leaves 4 or 5 inches long and almost an inch broad, when full grown." With this second description is plate 1147. It contains, first, a twig with two pistillate aments and leaves 4–6 cm. long and up to 1 cm. wide. It also carries what obviously is a short section of a vigorous autumnal shoot or root sprout, bearing two leaves 4–4.5 inches long and 0.8 inch wide, with long petioles.

Here, then, we have the origin of "leaves 4 or 5 inches long and almost an inch broad." As pointed out by the writer (4, 5), such shoots normally have leaves 1.5 to 2 or even 3 times as large as those on twigs which have borne fruits. Because taxonomic descriptions seldom cover such vigorous shoots, and because their deviation from the taxonomic norm has not been generally known, the meaning of this portion of Smith's description and plate has not been generally recognized.

American plants produce the same large leaves. In the writer's herbarium, a specimen from Quebec has leaves up to 4.8 by 0.6 inches; a New

York specimen up to 4.5–5 by 0.75 inches; two Michigan specimens have leaves up to 4 by 0.75 and 3.5 by 0.85 inches, respectively; and two Iowa specimens bear leaves to 3.5 by 1 and 4 by 1.1 inches, respectively. In late August, 1947, Dr. Turner collected sprouts from plants near Fort Saskatchewan, Alta. Five had blades to 5 inches long, one to 5.5 inches, and one (3 sprouts) had blades to 6 inches in length. Later collections might show longer blades.

But Smith, in 1803, threw further light on his description and plate. He writes (21, No. 1147): "The very young leaves are tinged with an elegant ferrugineous hue, especially in the radical shoots which spring up when a tree is cut down. Such shoots in some species differ greatly from the general appearance of the plant, and require in this genus to be particularly attended to." Here is an early recognition of the plant variation which the writer (4, 5) has been emphasizing. But, more important still, Smith could not have known about leaf hue on "radical shoots" of his *S. petiolaris* unless he actually had seen the growth from a cut tree. The only plants then known to him were those in the Crowe Garden, on which his description was based. This tells us almost certainly that the vigorous shoot in plate 1147, with leaves 4 or 5 inches long, was a root sprout, from which such leaf development would be normal.

Point 6. Claim of Different Scale Color in "British" and American Plants. Smith's original description (20, p. 123) says: "Black, hairy, often obovate, often notched, scales." A year later, he wrote (21, No. 1147): "Scales small, obtuse, often notched, black and hairy." Forbes, who also described only the plants growing in a botanic garden, wrote (10, p. 45): "Scales rounded, notched." Fernald (8, p. 47) says that the scales in American *S. gracilis* are "elongate, entire, and yellowish." What are the facts?

Flower scales, in any willow, are nearly as varying as the leaves, already discussed by the writer (4, 5, 6). As the ament emerges from the bud, the scales in all species are comparatively short and broad, and usually obtuse, no matter what their normal final shape. As the ament develops, the scales change in size, shape, and color. Linton (14, p. 1–2) made observations on such changes. These changes progress faster and farther in the basal portion of the ament than in the apical, in lax aments than in dense ones, and in fertilized aments than in unfertilized. Infertile pistillate aments usually do not become as long or as lax as normal, and their various floral organs do not develop so far. The scales, and the capsules with their pedicels, styles, and stigmas, usually remain shorter and therefore relatively broader than normal.

Male *S. petiolaris* was not known in Breat Britain until sent by Barratt (7, p. 4) and perhaps others some 25 years after the species was described in 1802. The original and later descriptions, therefore, were based on infertile pistillate aments, with consequent error in the knowledge of the actual and

relative size and shape of floral organs. This accounts for some of the differences recorded. In *Bebb 24,* grown in Illinois from English cuttings, the not fully developed scales are broad, and blackish at tip.

A study of numerous American specimens of *S. petiolaris* (and *S. gracilis*) shows that the scales vary from obovate, as the aments open, to oblanceolate at maturity. The apex varies from truncate to slightly erose, or rarely roundish. The color varies from light brown to brown or dark brown, as the scale ages, and is darkest at the tip. If quickly or poorly dried, they are blackish. They blacken more readily when dried while very young and in the "obovate" stage. Specimens were noted in which the young scales, poorly dried, were "obovate and blackish." They never are "yellowish," as described by Fernald, in the sense that those of *S. lucida, S. nigra, S. interior,* and their relatives are yellow or yellowish.

Point 7. Listing of Varieties of S. petiolaris Synonymous with S. gracilis. More problems arise when we consider the relationship of *S. gracilis* Andersson to the American *S. petiolaris* Smith. Fernald, refusing to recognize the latter, described (8, p. 46) his *S. gracilis* var. *textoris* var. nov. as having "capsulis ad 2 mm. longis; foliis maturis glabratis 4–10 cm. longis ad 2 cm. latis evidenter serrato-dentatis." It represents the larger plant here discussed as the true *S. petiolaris.* He then states (8, p. 47) that *S. gracilis* Andersson is "characterized by capsules only 5–7 mm. long and leaves entire or only obscurely denticulate, the mature ones only 2.5–7 cm. long and 3–11 mm. broad." It is not the purpose here to decide whether a variety of *S. petiolaris* with allegedly lower stature, smaller subentire leaves, and smaller capsules shall be recognized. The present object is to point out the errors made by Andersson, Schneider, and Fernald in discussing and creating certain names and combinations.

Andersson, in his compilation of the willows of North America (1), described *S. petiolaris* Smith on page 126 and compared it only with *S. sericea* Marsh., which he erroneously called "*S. grisea* Marsh." On page 127, five species later, he described his new species, *S. gracilis,* citing the "*S. rosmarinifolia* L." of Hooker (13, p. 148) as a synonym. He expresses much doubt as to the actual relationships of his *S. gracilis* but did not compare it with *S. petiolaris,* in spite of calling Hooker's plant a synonym. *S. gracilis* has been regarded by most later authors either as a synonym of *S. petiolaris* or as a variety of it, with smaller, narrower, mostly entire leaves.

To his new species, *S. gracilis,* Andersson attached a new variety, *rosmarinoides* Andersson. The only significant character assigned to it, in the very brief and jumbled Latin description, is "foliis apicem versus serrulatis," whereas of his *S. gracilis* he says "foliis . . . integerrimis." In other words, his var. *rosmarinoides* was the true *S. petiolaris,* which he does not even mention in discussing the relationships of his *S. gracilis.* Andersson seems

to have realized his error presently, for var. *rosmarinoides* is never mentioned again, in his two monographs (2, 3) of 1867 and 1868. In 1867, moreover, he reduced his *S. gracilis* to a subspecies of *S. petiolaris*. In 1868, he reduced it (3, p. 235) to a variety of *S. petiolaris,* thus ending his doubts as to their relationships. All of this would be unimportant but for the later erroneous actions of both Schneider and Fernald.

Schneider, in 1920, published (19, p. 19) his "*S. petiolaris* var. *rosmarinoides* comb. nov.," which he said was based on "*S. petiolaris* * *rosmarinoides* Andersson" of 1858. Here Schneider makes a first error. Andersson made no such combination in 1858, nor in any other year. As noted above, his combination in 1858 was "*S. gracilis* * *rosmarinoides,*" a variety which he immediately abandoned and never mentioned again. Schneider's second error was in assuming that the asterisk in Andersson's combination denoted a subspecies instead of a variety. It did not, as placed in that publication, and Gray correctly called it "var. *rosmarinoides*" in the simultaneous American edition (1, Am. ed. p. 67). Andersson's publications are full of the inconsistent use of numerals, Greek letters, and asterisks to denote varieties. If Andersson's variety really had been one of *S. petiolaris,* therefore, Schneider's combination would not have been "new," but a repetition. As Andersson made no such combination, Schneider's combination has no base.

Schneider cites *S. gracilis* Anders. of 1858, *S. petiolaris* subsp. *gracilis* Andersson of 1867, and *S. petiolaris* var. *gracilis* Anders. of 1868 as synonyms of his (Schneider's) "var. *rosmarinoides.*" Obviously they are not, because they represent the *gracilis* concept, whereas his "var. *rosmarinoides*" represents the *petiolaris* concept, as Andersson himself had recognized after 1858. In other words, Schneider was making *S. petiolaris* (*S. gracilis* var. *rosmarinoides* Anders.) a variety of itself.

Fernald (8, p. 46–47), in 1946, says of *S. gracilis:* "It is *S. petiolaris* vars. *rosmarinoides* (Anders.) Schneider and *angustifolia* Anders. . . ." Here he follows Schneider in the errors just discussed. But Fernald, refusing to recognize *S. petiolaris* as an American plant, had just described (8, p. 46) his "*S. gracilis* Anders. var. *textoris* var. nov." Actually, his variety *textoris* represents the American form with larger serrate leaves, which is the true *S. petiolaris* Smith. But because Andersson (1, p. 126–127), after describing *S. petiolaris,* redescribed the same form as *S. gracilis* var. *rosmarinoides* Andersson [var. nov.], Fernald's *S. gracilis* Anders. var. *textoris* var. nov. also is a synonym of Andersson's *S. gracilis* var. *rosmarinoides.*

Fernald was in error also in omitting *S. petiolaris* var. *gracilis* Andersson of 1868 from his above-named list of varieties of *S. petiolaris* which are synonyms of *S. gracilis.* Here he probably was misled by Schneider's erroneous reference.

WASHINGTON, D. C.

Literature Cited

1. **Andersson, N. J.** Bidrag till kännedom om de i Nordamerika förkommande pilarter (*Salices*). Oefvers. Vet.-Akad. Forhandl. **15**: 109–133. 1858. Printed simultaneously as: *Salices* boreali-Americanae.—A synopsis of the North Americana willows. Proc. Am. Acad. **4**: 50–78. 1858. [With the introduction in English and numerous footnotes by Asa Gray. This edition is commonly found as a reprint, pp. 1–32.]
2. ————. Monographia *Salicum.* K. Svensk. Vet.-Akad. Handl. **6**: i-iv, 1–180. *pl. 1–9.* 1867.
3. ————. Salicineae. *In:* De Candolle, Prodromus **16** (2): 190–331. 1868.
4. **Ball, Carleton R.** Illustrating plant organs for taxonomic purposes. Castanea **8**: 67–71. 1943.
5. ————. More plant study: fewer plant names. Jour. Arnold Arb. **27**: 371–385. 1946.
6. ————. Studying willows or making new sections in the genus *Salix.* Rhodora **49**: 37–49. 1947.
7. **Barratt, Joseph.** Salices americanae, North American Willows, . . . with notes and observations of a practical nature, showing the kinds best adapted for the useful arts, and those most esteemed in ornamental culture. 7 pp. (unnumbered). 1940.
8. **Fernald, M. L.** Technical studies on North American plants. II. Difficulties in North American *Salix.* Rhodora **48**: 13–16, 27–40, 41–49. *pl. 995–1006.* Ja, F, Mr, 1946.
9. **Fernald, M. L. & Wiegand, K. F.** A summer's botanizing in eastern Maine and western New Brunswick. Rhodora **12**: 135–146. *pl. 84.* 1910.
10. **Forbes, James.** Salictum woburnense: catalogue of willows, native and foreign, in the collection of the Duke of Bedford, at Woburn Abbey, systematically arranged. Pp. i-xx, 1–294. many colored pl. (unnumbered but usually cited by the number of the species represented). 1829.
11. **Gray, Asa.** Manual of the botany of the northern United States. p. 426; 1848; ed. 2, p. 413. 1856; and all subsequent editions.
12. **Hooker, W. J.** British Flora. ed. 1, **1**: 419. 1820; and all subsequent editions.
13. **Hooker, W. J.** Flora boreali-americana. **2**: 144–153. 1839.
14. **Linton, F. B.** A monograph of the British willows. Pp. 1–92. 1913. [Supplement to Jour. Bot. 1913.]
15. **Loudon, J. C.** Arboretum et fruticetum brittanicum, or the trees and shrubs of Britain, native and foreign. **3**: 1453–1636. 1838. [Many figs. & plates, some numbered, some not.]
16. **Macoun, John.** Catalogue of Canadian plants. **1** (3) (*Salix*): 444–455. 1886; **2** (5): 356–361. 1890.
17. **Pursh, Frederick.** Flora Americae septentrionalis: or a systematic arrangement and description of the plants of North America. **2**: 608–618. 1814.
18. **Rosendahl, Carl Otto, & Butters, Frederic K.** Trees and shrubs of Minnesota. Pp. 385. *illus.* 1928.
19. **Schneider, Camillo.** Notes on American willows. IX, b. The species of the Section *Griseae.* Jour. Arnold Arb. **2**: 13–25. 1920.
20. **Smith, James Edward.** Remarks on some British species of *Salix.* Trans. Linn. Soc. **6**: 110–124. 1802.
21. ————. English Botany **16**: 1145–1147 (No. & Pl. 1147). 1803.

22. ———————. Flora brittanica **3**: 1039–1079. 1804. [Latin ed. of Engl. Bot., with same descriptions.]

23. ———————. English flora **4**: 163–233. 1828.

24. **Torrey, John.** A flora of the State of New York **2**: 204–213, *pl. 117–120.* 1843.

25. **White, F. Buchanan.** A revision of the British willows. Jour. Linn. Soc. Bot. **27**: 333–457, *pl. 9–10.* 1890.

26. **Wood, Alphonso.** Class-Book of botany, . . . with a flora of the United States and Canada. Pp. 832. *illus.* 1865 [*Salix*, pp. 651–655.]

BULLETIN OF THE TORREY BOTANICAL CLUB
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EUPHORBIA MACULATA: A REJOINDER[1]

LEON CROIZAT

In his comments (Bull. Torrey Club **74**: 332. 1947) upon my notes (Bull. Torrey Club **74**: 153. 1947) concerning the proper application of *Euphorbia maculata* L., Fosberg charges me with being guilty of what he calls a curious oversight, because I failed to pay attention to a putative "typification" of *E. maculata* effected by Linnaeus in the *Mantissa.*

The readers of the discussion between Fosberg and myself would be poorly served, I believe, if this charge were allowed to stand. It is a fact that I have not discussed the "typification" of the *Mantissa,* and even less deemed it relevant, for the reason that I hold to the opinion that in the *Mantissa* no typification was ever made, as Fosberg believes. In the *Mantissa,* Linnaeus merely added one more reference to the garbled synonymy of the *Species Plantarum.*

I am not alone in this opinion, for this opinion is shared by Boissier, a taxonomist of unusual discrimination and ability, and the uncounted thousands of taxonomists who, implicitly or explicitly, have constantly accepted *E. maculata* in the sense I myself hold.

Finally, I should like to point out that stability of nomenclature is one of the keystones of the *Rules.* Botanists who believe that Fosberg has a case, after all, are bound to notice that only *absolute proof* that the previous sense of *E. maculata* is illegitimate may justify their rejecting this sense in order to follow the proposed new usage. No such proof has been created by the assertion that I have supposedly overlooked a text which I, and many other botanists, deem irrelevant.

MINISTERIO DE AGRICULTURA Y CRÍA, DEPARTAMENTO DE
INVESTIGACIONES FORESTALES
CARACAS, D. F., VENEZUELA

[1] The editor believes that no good purpose will be served by prolonging this controversy in these pages, unless new facts are discovered. The present paper is published only in deference to Dr. Croizat's fear that a misinterpretation of his position might result if the matter were allowed to rest with Dr. Fosberg's reply.

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—II

BASSETT MAGUIRE AND COLLABORATORS

CYCLANTHACEAE

CYCLANTHUS BIPARTITUS Poit. BRITISH GUIANA locally frequent, low ground, mixed mora forest, banks Kamuni Creek, Groete Creek, Essequibo River, *22938*. Widely distributed from the Antilles, through the Amazon Basin to Peru. Known from several stations in British Guiana. Apparently unrecorded from Surinam.

CARLUDOVICA CORONATA Gleason. BRITISH GUIANA: climber, in dense thickets, second growth in windfall opening, mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22867a;* hemi-epiphyte, Baramanni Creek, Waini River, N. W. D., *F2342*. Apparently known definitely only from British Guiana, where it is widely distributed. Sandwith[22] records two specimens from Tobago that may be referable to *C. coronata*.

Carludovica Fanshawei Maguire, sp. nov. Herbae scandentes; laminis ad ⅔ vel basis bipartitis, segmentis late oblanceolatis, abrupte brevi-acuminatis, 5-nerviis; spathis ut videtur 2; staminibus numerosis, receptaculis concavis; segmentis perianthiis floribus femineis basis connatis, lobis late triangularibus, stigmatibus sessilibus; seminibus ignotis.

Climbing epiphyte; stems fleshy, 1–2 cm. thick; petioles 12–18 cm. long, the broadly clasping sheaths 4–5 cm. long, the blades bipartite for ⅔ their length, 15–20 (22) cm. long, the segments 10–15 cm. long, 5–7 cm. broad, oblanceolate, abruptly short-acuminate, 5-nerved on each surface; peduncle ca. 10 cm. long, subtended by several imbricated bracts 5–8 cm. long; spathes apparently 2, from the upper portion of the peduncle, caducous; spadix 5 cm. long, 2 cm. broad; stamens numerous, covering entire surface of the concave receptacle, anthers 0.5 mm. long, filaments 0.6–0.8 mm. long, pedicels flattened or sharply 3-angled, ca. 1.2–1.5 mm. long; perianth members of the pistillate flower connate at the base, the lobes broadly triangular, 1.5–2.0 mm. high, bearing a thickened structure internally near the apex; stigmas essentially sessile, ovate-oblong, more or less remote, receptive surface thick, linear.

TYPE: hemi-epiphyte with fleshy stem 1–2 cm. thick, clinging by adventitious roots but rooted in ground, to 15 feet high, leaves bifurcate, spadix green, spathe fallen, on trees in marsh forest, 12 miles up Kaituma River, British Guiana, March 14, 1945, *Fanshawe 514*. New York Botanical Garden. Known only by the type collection.

Carludovica fimbriata Maguire, sp. nov. Herbae terrestres; laminis foliorum ad ⅔ vel basin versus bipartitis, segmentis lanceolatis, acuminatis, apicibus obtusis, vaginis terminatis ad extremum manifeste fimbriatis; spathis ut videtur 2; discis florum stamineorum planis, lobis 5, perianthiis lobis orbiculatis, staminibus 5–7, filamentis filiformibus, brevibus, anthera-

[22] Kew Bull. **1938**: 380.

rum lobis divergentibus, perianthii lobis florum femineorum 4, stigmatibus sessilibus, planis, cruciformis; seminibus ignotis.

Terrestrial herb; caudex erect, fleshy, about 5 cm. or less long, leaves 2–4 surmounting a short crown, the petioles 10–30 cm. long, 2–3 mm. broad, rigid, adaxial side shallowly canaled, blades some 15–35 cm. long, bipartite for more than ⅔ their length, the segments 3–6 cm. wide, entire, lanceolate, principal veins 14–16, alternately raised and impressed, the reverse condition obtaining on the opposite surface, the apex slender, acuminate, finally blunt, the sheaths 4–7 cm. long, broadly enfolding the stems, truncately terminating in an arcuate vascular plexus beyond which extend the 2–4 cm. long auricular ligules in which the mesophyl tissues quickly disintegrate, leaving a conspicuous fringe of vascular fibers; peduncles 1–3, 10–15 (17) cm. long, slender, rigid; spathes apparently 2, affixed near the apex of the peduncle, the inner about 3 cm. long, lanceolate; spadices 10–13 mm. long, about 10 cm. thick; pedicels of staminate flowers ca. 0.5 mm. long, equally broad and much flattened, disc plane, the 5 lobes narrowly and acutely lanceolate, ca. 0.5–1.0 mm. long, perianth lobes rounded, ca. 0.3 mm. long, whitish-margined, stamens 5–7, filaments delicate, ca. 0.3 mm. long, anther lobes 0.6–0.7 mm. long, divergent; perianth members of the pistillate flowers 4, erect, broadly triangular-ovate, chartaceous and involute, at length becoming pustulate, stigma 3–3.5 mm. across, sessile, plane, cruciform, the lobes oblong-orbicular, pustulate, the margins stramineous, the darker stigmatic surface linear; seed unknown.

TYPE: frequent, among rocks along small stream, mixed montane forest, Km. 15, Coppenam River Watershed, Surinam, July 23, 1944, *Maguire 24159*. New York Botanical Garden.

Carludovica fimbriata is to be associated with *C. pygmaea* Gleason, *C. nana* Gleason, and *C. angustissima* Sandwith, from British Guiana, and *C. insularis* Gleason from Tobago, British West Indies, all belonging to Section I as arranged by Gleason[23] in his review of Demerara *Carludovica*.

The name *fimbriata* is suggested for our new species because of the conspicuous fringed remnant of the leaf-sheath auricles, a character that seems to obtain throughout the section.

CARLUDOVICA GLANDULOSA Gleason. BRITISH GUIANA: frequent, in damp soil of mixed mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22830*. Known previously only from the type, *Jenman 2105*, Mt. Russell District, British Guiana.

CARLUDOVICA LATIFRONS Drude. BRITISH GUIANA: hemi-epiphyte with fleshy stems 2–4 cm. thick, 12 miles up Kaituma River, *F 2405;* terrestrial, stems 30 cm. tall, dicymbe forest, Kaieteur Gorge, 1 mile below Falls, *23533*. SURINAM: frequent, mixed high forest, rocky south slopes of Arrowhead Basin, Tafelberg, *24604* (sterile). The preceding three collections are only tentatively referred to this species, none being positively identifiable. British Guiana through the Amazon Basin to Peru.

CARLUDOVICA SARMENTOSA Sagot ex Drude. BRITISH GUIANA: climber from crown of mora tree, Waiapi Creek, Lower Mazaruni River, *F1415*. British Guiana, the Amazon Basin, south to the Province of Bahia and Rio de Janeiro.

CARLUDOVICA STYLARIS Gleason, Bull. Torrey Club **56**: 7. 1929. With the abundance of new material now available, it is desirable to offer the fol-

[23] Bull. Torrey Club **56**: 2. 1929.

lowing emended description. From the additional characters here recognized it seems evident that *C. stylaris* and probably also *C. glandulosa* belong to Sect. *Sarcinanthus* (Oersted) Gleason.

Terrestrial herb; stems usually 5 cm. or less long; petioles slender, 4–10 dm. long, the clasping sheath 1–2 dm. long, without free auricles; blades 3–8 dm. long, bipartite for less than ¼ their length, the segments 5–9 cm. broad, with 4 or 5 principal nerves, abruptly acuminate; peduncle 1.5–3.0 dm. long, invested with several basal sheathing narrow bracts, as much as 10 cm. long; spathes 3, affixed above the middle of the peduncle, the lowermost lanceolate, 8–10 cm. long, acuminate, the upper two broader and somewhat less long; spadices 3–6 cm. long, 2–4 cm. thick; staminate flower asymmetrical, the pedicels thick, ca. 0.5 mm. long, perianth lobes 5–7, rounded, fleshy, ca. 0.3 mm. long, each bearing a conspicuous external basal gland; stamens numerous, ca. 30, completely covering the plane or slightly concave receptacle, anthers ca. 0.7 mm. long, oblong-quadrangular, the connective extending beyond the anther sacs as a blunt projection, the filaments less than 0.2 mm. long, thick, expanded into conspicuous swollen subglobose bases; perianth lobes of the pistillate flower broadly triangular, fleshy, bearing a thick umbo within; styles pyramidal, stout, ca. 1 mm. long at maturity, probably longer at anthesis, stigmas connate, globose-oblong, the stigmatic surface linear; ovary completely sunken into the axis of the spadix, unilocular, the columella and ovules suspended from the summit; seed fusiform, ca. 2.5 mm. long, 0.75 mm. broad, funiculus 1 mm. long, apical appendage awl-shaped, 1.5–2.0 mm. long.

BRITISH GUIANA: occasional, leaves bipartite, leathery, spadix white, cylindrical, from forest streamside, Kaieteur Plateau, vicinity Kaieteur Falls, British Guiana, *23107*. SURINAM: frequent, low damp ground under high bush, 0.5 km. north of Savanna II, Tafelberg, Surinam, 560 meters altitude, *24407*; common, low bush east of North Ridge, near escarpment, Tafelberg, Surinam, 545 meters altitude, *24288*. British Guiana and Surinam.

MAYACACEAE

MAYACA LONGIPES Mart. ex Seubert. BRITISH GUIANA: locally frequent aquatic, sterile, shallow embayment, Potaro River landing, a mile above Kaieteur Falls, *23106*. SURINAM: lodged in branches of shrubs overhanging Saramacca River, vicinity Pakka Pakka, *23961* (sterile). No *in situ* material seen. British Guiana south to the Amazon River drainage.

XYRIDACEAE

Abolboda acaulis Maguire, sp. nov. Plantae perennes; caudicibus brevissimis; foliis numerosis lineari-lanceolatis, 7–9-nerviis, valde abrupteque aristatis; spicis sessilibus; sepalis 2 vel 3, naviculiformibus, apiculatis; corollis caeruleis, hypocrateriformibus; staminibus 3, staminodiis 3, filiformibus; ovariis oblongo-ovatis, puberulentibus, 3-locularibus; stigmatibus crateriformibus, fimbriatis, appendicibus 3; capsulis papillosis; seminibus globosis, costatis.

Plants perennial, acaulous; caudex short, simple or cespitose, fleshy, 1–2 cm. high; leaves numerous, densely imbricate, 8–18 mm. long, 1.5–2.5 mm. broad, linear-lanceolate, glabrous, subcoriaceous, prominently 7–9-nerved, the base dilated, the apex abruptly terminating in a stiff awn 1–1.5 mm.

long; spike sessile, surpassed by the upper leaves, several-flowered; bracts 4–6 mm. long, similar to the leaves but less firm, scarious, the nerves inconspicuous, the awn 0.5 mm. or less long; sepals 2 or occasionally 3, boat-shaped, 6–7 mm. long, acute, apiculate, scarious; corolla blue, hypocrateriform, ca. 15 mm. long, the lobes broadly elliptic, 5–7 mm. long; stamens 3, inserted below the base of the lobes, anthers ca. 1 mm. long, filaments ca. 1 mm. long; staminodia 3, filamentous, nearly as long as the style, enlarged somewhat distally, acute; ovary oblong-ovate, minutely pubescent at summit, ca. 2 mm. long, 3-locular, placenta central, ovules numerous; style 8–10 mm. long, stigma crateriform, fringed, ca. 1 mm. long, style-appendages 3, basal 0.5–0.8 mm. long, broadly clavate, sometimes the third much elongate and less clavate, or only 1 appendage present, or all obsolete; capsule 3–3.5 mm. long, chartaceous, apex obtuse or truncate, papillose; seed 0.5–0.7 mm. long, globose, 14–15 longitudinally ribbed, dark red-brown.

TYPE: flowers blue, locally common, shallow sand pockets in conglomerate bed rock, vicinity rest house, Kaieteur Plateau, British Guiana, April 30, 1944, *Maguire & Fanshawe 23096*. New York Botanical Garden.

Abolboda acaulis, but for its acaulescent habit, superficially resembles *A. americana*, with which it is usually associated in the field. As in *A. grandis*, staminodia are well developed in *A. acaulis*, a character apparently not before observed in the genus. The presence of staminodia in at least these two species, the unbranched stigma, and the frequent total absence of style appendages in *A. acaulis* diminish somewhat the hitherto assumed[24] very sharp distinction between *Abolboda* and *Xyris*.

ABOLBODA AMERICANA (Aubl.) Lanj. The collections here reported further our understanding of variation in *A. americana* and make desirable an extension of Lanjouw's[25] recently emended description. Our additional material shows: the leaves to reach 12 cm. in length, 1.5 mm. in width, the apex minutely apiculate or completely rounded; the scapes 15 cm. in length; the floral bracts 7 mm. in length, with boat-shaped and prolonged thickened blunt or apiculate appendages, 0.5–2.0 mm. long; capsule 3.5–4.5 mm. in length, firm, valves obtusely triangular at the apex; seed 0.5–0.7 mm. long, broadly oblong, light gray-brown.

Lanjouw (op. cit.) has altogether satisfactorily established the proper name *A. americana* for this species, and has properly brought the name *A. Poeppigii* Kunth into synonymy under it.

The question is now raised as to whether *A. imberbis* is not also conspecific with *A. americana*. The two were distinguished by Malme[26] in the following manner (and by Suessenguth and Beyerle[27] in essentially the identical phraseology, but in German):

A. Folia 3–4 cm longa, circiter 1 mm lata, 5–7-nervia. Bracteae spicae apiculo subfiliformi, usque 8 mm longo munitae.
A. imberbis Humb. & Kunth (1825). (Guyana.)

B. Folia 3–4 cm longa, circiter 0.5 mm lata, trinervia. Bracteae spicae apiculo brevi, circiter 1 mm longo munitae.
A. Poeppigii Kunth (1843) (priori valde affinis, forte non diversa). (Pará.)

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[24] **Suessenguth, K. & Beyerle, R.** Über die Xyridaceengattung *Abolboda*, Humb. & Bonpl. Bot. Jahrb. **67**: 132–142. 1935.

[25] Rec. Trav. Bot. Néerl. **34**: 493. 1937.

[26] Ark. Bot. **19**[13]: 1–8. 1925.

[27] Bot. Jahrb. **67**: 139. 1935.

Leaf length and width are variable, indeed material from the Kaieteur Plateau, and certainly representing a single species, alone has leaves from 2–12 cm. long and from 0.5–1.5 mm. wide, thus breaking down the leaf-width difference as given in the above key. But another leaf character seems to be of significance. In plants from the coastal savannas of Surinam and from the Kaieteur Plateau, the leaves are somewhat fleshy, thickish, and more of less rigidly erect or ascending. But in collections from Tafelberg in Surinam and Esmeralda in Venezuela, the leaves are thin and lax. Coincident with this leaf difference, the plants from the latter two areas have 1–3-flowered spikes, thick bracts 5–6 mm. long with slender, short, awn-tipped appendages, while the spikes of plants from coastal Surinam and Kaieteur are usually 3–5-flowered and have broader bracts usually 6–7 mm. long with thicker, blunt, or merely apiculate appendages.

There is little question but that both forms are of the same species, although they probably represent good varieties. Furthermore, it is probable that the smaller variant represents specimens that must come under *A. imberbis* H.B.K., since in the original description[28] the leaves were characterized as "linearia, graminea, ..." the bracts as "Glumae, ... uniflorae, lanceolatae, acuminatae." Should the bracts have been provided with an appendage "8 mm." long, longer than the body of the glume itself, Humboldt, Bongland, and Kunth would hardly have written merely "lanceolatae, acuminatae." It must be assumed, then, that the Atabapo plants are similar to those from Esmeralda, some 100 or more miles to the eastward, now before me, and that the ascription by Malme of "bracteae spicae apiculo subfiliformi, usque 8 mm longo munitae" must have resulted in some error in phraseology.

Accordingly, the two varieties of the species are delimited as follows:

ABOLBODA AMERICANA var. **americana** Maguire, var. nov. *Xyris americana* Aubl. Hist. Pl. Gen. Franç. 1: 40, t. 14. 1775, as to type; *Abolboda Poeppigii* Kunth, Enum. Pl. **4**: 27. 1843. Leaves usually 3–12 cm. long, 0.5–1.5 mm. wide, fleshy, obtuse or apiculate, 3-nerved; scapes usually 5–15 cm. long; spikes 3–5-flowered; bracts 5–7 mm. long, the appendage obtuse, sometimes apiculate; seed 0.6–0.7 mm. long.

TYPE: "Cayenne. *Mr. Fusee, Aublet.* 1775." BRITISH GUIANA: common tufted perennial in damp sand or shallow water, overlying bed rock conglomerate, Kaieteur Plateau, *23116; 23178; 23188.* SURINAM: inundated open savanna, Zanderij I, *Stahel 115;* grass savanna, Zanderij II, *23666.* Open wet sandy habitats, Pará to Surinam and British Guiana.

A. AMERICANA var. **imberbis** (H.B.K.) Maguire, comb. nov. *A. imberbis* H.B.K. Nov. Gen. Sp. **1**: 256. 1815. Leaves usually 2–3 (4) cm. long, 0.5–0.75 mm. wide, apiculate, thin, lax, strongly 3-nerved; spikes 1–3-flowered; bracts 5–6 mm. long, the appendage slender, short-awned; seed 0.5–0.6 mm. long.

TYPE: "Crescit in arenosis Guayanae ad flumen Atabapo." International boundary between Colombia and Venezuela. VENEZUELA: in running stream in woods, Grand Savanna, Section I, Esmeralda, November 1, 1929, *Tate 229.* SURINAM: frequent, Savanna I, Tafelberg, *24211.* Savannas of southern Venezuela, Tafelberg in Surinam.

Abolboda psammophila Maguire, sp. nov. Plantae perennes; caudicibus brevissimis; foliis numerosis, dense imbricatis, sine nerviis vel obscure

[28] H.B.K. Nov. Gen. Sp. 1: 256. 1815.

3–5-nerviis, abrupte apiculatis; sepalis 2, lanceolato-acuminatis; floribus ignotis; capsulis oblongis, glabris; seminibus globosis, costatis.

Plants perennial, simple or cespitose, caudex short, fleshy, acaulous, 1–2 cm. high; leaves numerous, densely imbricate, 5–12 mm. long, 1.0–1.5 mm. broad, lanceolate, becoming terete toward the obtuse, abruptly apiculate apex, nerveless or indistinctly 3–5-nerved, strictly ascending or somewhat outcurved or incurved; the bracts a little broader, acute, terminating in a distinct awn; sepals 2, lanceolate-acuminate, 5.0–5.5 mm. long, subscarious; flowers not seen; capsule 2.5–2.8 mm. long, oblong, subscarious, chartaceous at the acute, totally glabrous apex; seed 0.5–0.6 mm. long, globose, obovate, grayish red-brown, 12–16 longitudinally ribbed.

TYPE: frequent acaulescent perennial, open sandy areas subject to frequent inundation, west side of railway, Zanderij II, Surinam, June 3, 1944, *Maguire & Stahel 23667*. New York Botanical Garden.

Similar to *A. acaulis* from the Kaieteur Plateau, British Guiana, but the leaves nerveless or essentially so, blunt, and ascending, and the capsules acute and glabrous, whereas in the Kaieteur species the leaves are broader, strongly nerved and awned, and the capsule firmer, obtuse, and papillose.

ABOLBODA GRANDIS Griseb. BRITISH GUIANA: perennial cespitose herb with thick fleshy rootstock, stems to 1 m. high, ephemeral blue flowers, frequent in damp sand, Kaieteur Plateau, *23148*. Venezuela, the Guianas, Pará, and Amazonas.

ABOLBODA GRANDIS var. MINOR Spruce apud. Malm. SURINAM: frequent, stony bank Geijskes Creek, Black Water Camp (5), Coppenam River Headwaters, *24176;* Savanna I, Tafelberg, *24215*. A weak variant recorded previously from Altos, Amazonas, but probably throughout the range of the species.

ERIOCAULACEAE[29]

Eriocaulon heterodoxum Moldenke, sp. nov. Herba parva acaulescens; foliis graminoideis 2–8.5 cm. longis, 3–4 mm. latis, rectis acutis vel subacutis utrinque glabris multinervatis plusminus fenestratis; vaginis 2–3 cm. longis, glabris, laminis erectis arcte acutis vel subacuminatis, adpressis; pedunculis 3–12, brunnescentibus, 5–12 cm. longis, glabris; receptaculo glabro; bracteis involucrantibus brunneis elliptico-lanceolatis vel ellipticis obtusis glabris nitidis; bracteis receptaculi late obovatis glabris; floribus ♂ dimeris; floribus ♀ trimeris.

Small acaulescent herb; leaves grass-like, 2–8.5 cm. long, uniformly dark green on both surfaces, erect, 3–4 mm. wide, acute or subacute at apex, glabrous on both surfaces, many-nerved, the younger ones and the basal portions of the older ones more or less fenestrate, the venation indiscernible on the apical portion of older leaves; sheaths rather loose, 2–3 cm. long, shorter than the leaves, glabrous, obliquely split at the apex, the blade erect, sharply acute or subacuminate, appressed, not at all divergent; peduncles comparatively stout, 3–12 per plant, 5–12 cm. long, erect, brunnescent, several-costate, twisted, glabrous; heads brown, obconic-hemispheric, 3–6 mm. wide; involucral bractlets brownish, elliptic-oblanceolate or elliptic, about 2.6 mm. long and 1.3 mm. wide, obtuse at apex, glabrous, shiny; receptacle glabrous; receptacular bractlets broadly obovate, about 1.5 mm. long and 0.9 mm. wide, brownish toward the apex, abruptly subacute at the apex,

[29] By Harold N. Moldenke.

long-cuneate to the base, convex on the back, glabrous, not bearded; staminate florets few: sepals 2, connate only at the very base, oblanceolate, somewhat falcate, convex on the back, brownish except at the very base, about 1 mm. long and 0.3 mm. wide, subacute and irregularly erose-laciniate at the apex, glabrous, not bearded; petals 2, subhyaline, united into a very slender tube about 1.3 mm. long, glabrous, free above, the lobes 2, about 0.34 mm. long, subacute, glabrous, bearing a small black gland at the apex, not bearded; stamens 4, 2 opposite and 2 alternate with the petals; rudimentary style black, 2-lobed; pistillate florets very numerous: sepals 3, separate, narrow-elliptic, about 1.3 mm. long and 0.2 mm. wide, hyaline or very lightly stramineous, acute at apex, glabrous, eglandular, not bearded; petals 3, narrow-elliptic, hyaline, separate, 1–1.3 mm. long, about 0.2 mm. wide, acute at apex, glabrous, bearing a small black gland at the apex; pistil single; style 0.4–0.5 mm. long, glabrous; stigmas 3, about 1 mm. long or longer, divergent; ovary subglobose, about 0.4 mm. long and wide, angular, glabrous, 3-celled, 3-ovulate.

TYPE: sandy forest shore below high tide limit on the river tidal flats, Mazaruni Forest Station, British Guiana, May 23, 1944, *Maguire & Fanshawe 23570.* New York Botanical Garden. The collectors describe the species as "local." It is a most remarkable species because of having trimerous pistillate and dimerous staminate florets in the same head!

PAEPALANTHUS BIFIDUS (Schrad.) Kunth. BRITISH GUIANA: 50 miles north of Bartica, *22974;* in white sand, Bartica Road, *23561;* low annual from open spaces on white sand, Sandhills, Demerara River, *F905.* Colombia and the Guianas to Minas Geraes, Brazil.

Paepalanthus brunneus Moldenke, sp. nov. Herba caulescens; caulis 2–10 cm. longis, dense foliatis; foliis graminoideis, 1–2 cm. longis, 1–4 mm. latis, argute acutis vel submucronulatis brunnescentibus utrinque glabris multinervatis; vaginis gracilibus arcte adpressis 1–1.8 cm. longis, brunnescentibus, glabris vel ad apicem parcissime pilosis, laminis erectis argute acutis vel submucronulatis; pedunculis gracilibus, 2–7 complanatis, 5–12 cm. longis, glabris; bracteis involucrantibus ellipticis brunneis acuminatis ad marginem et versus apicem villosis; receptaculo dense villoso; bracteis receptaculi oblanceolatis brunneis barbatis; floribus trimeris.

Caulescent herb; stems very slender, 2–10 cm. long, simple, erect or ascending, often quite abbreviated, densely leafy; leaves grass-like, 1–2 cm. long, 1–4 mm. wide at the base, sharply acute or submucronulate at the apex, rather uniformly dark green on both surfaces, brunnescent in drying, glabrous on both surfaces, 7–15-nerved with close parallel veins, sometimes faintly fenestrate; sheaths slender, closely appressed to the peduncle, 1–1.8 cm. long, brunnescent, equaling the leaves, glabrous throughout or with a very few scattered dark colored hairs near the apex, obliquely split at the apex, the blade firm, erect, sharply acute or submucronulate at the apex; peduncles slender, brunnescent, 2–7 per plant, 5–12 cm. long, several-costate, flattened in drying, erect, glabrate throughout; heads dark brown, hemispheric, about 2 mm. high and 2–4 mm. wide; involucral bractlets elliptic, 1.8–2 mm. long, about 0.7 mm. wide, brown, acuminate at the apex, villous at the margins at and near the apex, otherwise glabrous and shiny; receptacle very densely long-villous; receptacular bractlets oblanceolate, about 1.5 mm. long and 0.5 mm. wide, brown, bearded at the apex with brown divergent blunt hairs; staminate florets stipitate: sepals 3, connate only at

the very base, oblanceolate, brown, about 1 mm. long and 0.3 mm. wide, erect, firm, rounded at the apex and there densely bearded with short erect stramineous hairs; petals 3, connate into a hyaline infundibular tube, involute at apex, eglandular; stamens 3, slightly exserted from the corolla-tube; anthers 4-celled; pistillate florets: sepals 3, connate only at the very base, oblanceolate, brown, erect, firm, about 1 mm. long and 0.3 mm. wide, bearded on the back at the apex with short erect stramineous hairs; petals 3, separate, similar to the sepals or slightly smaller and narrower, villous on the back; pistil about 1.3 mm. long, glabrous; stigmas 3; ovary 3-celled.

TYPE: locally common, chiefly on white sand, secondary scrub forest, Amatuk Portage, Potaro River Gorge, British Guiana, April 27, 1944, *Maguire & Fanshawe 23020*. New York Botanical Garden. Described by the collectors as "erect annual, to 20 cm. high." The species resembles in general habit *Eriocaulon caesium* Griseb. of Trinidad.

PAEPALANTHUS CAPILLACEUS var. PROLIFERUS Gleason. BRITISH GUIANA: aquatic in swiftly flowing stream, Kaieteur Plateau, *23243*. The variety is known only from British Guiana and Amazonas, Venezuela.

PAEPALANTHUS FASCICULATUS (Rottb.) Körn. BRITISH GUIANA: in white sand of clearing, Kangaruma, *23001;* in white sand, Bartica Road, *23560*. SURINAM: common in sand along railroad near Km. 70, *23618;* frequent in sandy soil of open places, islands of Brokoboto Rapids, 3 hours above Pakka Pakka, Saramacca River, *23983*. Colombia and Venezuela through the Guianas to northern Brazil.

PAEPALANTHUS FASCICULATUS f. TENELLUS Herzog. SURINAM: in sand at base of escarpment, Tafelberg, *24677;* frequent at base of dripping cliffs, north escarpment, Tafelberg, *24191;* frequent, moist rocks at base of north escarpment, Tafelberg, *24298*. The form is known only from Surinam and Amazonas, Venezuela.

Paepalanthus filipes Moldenke, sp. nov. Herba parva acaulescens; foliis rosulatis brunnescentibus linearibus 1–1.5 cm. longis, ca. 1 mm. latis, erectis vel plerumque reflexis utrinque glabris; vaginis arcte adpressis ca. 1.5 cm. longis brunnescentibus glabris, laminis brevibus erectis obtusis; pedunculis filiformibus stramineis vel brunneis 4.5–9 cm. longis tricostatis glabratis; bracteis involucrantibus stramineis elliptico-oblanceolatis vel ellipticis abrupte acutis glabris; receptaculo longe villoso; bracteis receptaculi parvis paucis hyalinis oblanceolatis acutis glabris; floribus trimeris.

Small acaulescent herb; leaves rosulate, uniformly dark green on both surfaces, brunnescent in drying, linear, 1–1.5 cm. long, about 1 mm. wide, erect or more usually somewhat reflexed, glabrous on both surfaces, rather blunt at the apex, the venation indiscernible; sheaths narrow-cylindric, closely appressed to the peduncle, surpassing the leaves, about 1.5 cm. long, brunnescent, glabrous, obliquely split at the apex, the blade short, erect, blunt; peduncles filiform, stramineous or brunneous, 4.5–9 cm. long, 3-costate, twisted, glabrate or with a few scattered hairs toward the base and apex; heads stramineous, obconic or hemispheric, 1.5–4 mm. wide; involucral bractlets stramineous, elliptic-oblanceolate or elliptic, about 1.5 mm. long and 0.5 mm. wide, abruptly acute at the apex, glabrous, not bearded; receptacle long-villous; receptacular bractlets small, few, hyaline, oblanceolate, about 0.6 mm. long and 0.1 mm. wide, acute at the apex, glabrous; staminate florets: sepals 3, connate only at the very base, hyaline, oblanceolate, about 1.3 mm. long and 0.5 mm. wide, subacute at the apex, convex on the back,

long-villous at the very base, otherwise glabrous, not bearded; petals 3, united to form a very slender, stramineous, infundibular tube about 1 mm. long, glabrous, separate and involute at the apex, the lobes hyaline; stamens 3, slightly exserted; pistillate florets: sepals hyaline, oblanceolate, separate or connate only at the very base, about 1.5 mm. long and 0.5 mm. wide, acute at the apex, sparsely villous along the margins, convex on the back, not bearded; petals 3, narrowly elliptic-oblanceolate, hyaline, about 1.5 mm. long and 0.2 mm. wide, obtuse or subacute at the apex, long-villous on the back, not bearded, eglandular; pistil about 1.3 mm. long, glabrous; ovary 3-celled, 3-ovulate; stigmas 3.

TYPE: locally common, chiefly on white sand, secondary scrub forest, Amatuk Portage, Potaro River Gorge, British Guiana, April 27, 1944, *Maguire & Fanshawe 23021*. New York Botanical Garden. The collectors describe it as an "erect annual to 12 cm. high; flower heads whitish."

Paepalanthus griseus Moldenke, sp. nov. Herba parva caulescens; caulis 2–4 cm. longis, simplicibus dense foliatis; foliis graminoideis 0.8–3 cm. longis, 2–5 mm. latis, argute acuminatis vel mucronulatis utrinque laxe albo-villosis; vaginis gracilibus arcte adpressis 1–1.5 cm. longis laxe villosis, laminis erectis acuminatis saepe divergentibus; pedunculis gracilibus 3–17 stramineis 4–10 cm. longis, 5-costatis glabris; bracteis involucrantibus oblongis brunneis ad apicem triangulari-acutis dense barbatis; receptaculo longe villoso; bracteis receptaculi brunneis oblanceolatis subacutis dorso villosis ad apicem barbatis; floribus trimeris.

Small caulescent herb; stems abbreviated, 2–4 cm. long, densely leafy, erect, simple; leaves grass-like, light green on both surfaces, 0.8–3 cm. long, 2–5 mm. wide at the base, sharply acuminate or mucronulate at the apex, loosely white-villous on both surfaces, with numerous parallel veins, not fenestrate; sheaths slender, cylindric, closely appressed to the peduncle, equaling the leaves, 1–1.5 cm. long, loosely villous, more sparsely so toward the apex, obliquely split at the apex, the blade firm, erect, acuminate, the apex often slightly divergent; peduncles slender, 3–17 per plant, 4–10 cm. long, stramineous, about 5-costate, twisted, not flattened, glabrous; heads hemispheric, gray, 3–5 mm. wide; involucral bractlets oblong, about 1.8 mm. long and 0.7 mm. wide, triangular-acute at the apex, brown, densely bearded on the back at the slightly incurved apex; receptacle long-villous; receptacular bractlets brownish, oblanceolate, about 2.3 mm. long and 0.7 mm. wide, subacute at apex, villous on the back and bearded at the apex; staminate florets: sepals 3, connate only at the very base, oblanceolate, about 0.7 mm. long and 0.35 mm. wide, brownish, obtuse at the apex, glabrous except for the densely bearded apex; petals 3, united into a very slender hyaline infundibular tube about 0.7 mm. long, separate and involute at the apex, glabrous, the lobes about 0.4 mm. long; stamens 3, very slightly exserted from the corolla-limb; pistillate florets: sepals 3, separate or connate only at the very base, broadly elliptic, about 1.3 mm. long and 0.5 mm. wide, brownish, obtuse at the apex, convex on the back, villous on the upper half and densely bearded at the apex on the back; petals 3, separate, narrow-elliptic, about 1 mm. long and 0.3 mm. wide, obtuse at the apex, brownish, villous on the back from below the middle to the apex, densely bearded at the apex; pistil about 1.3 mm. long, glabrous; ovary 3-celled, 3-ovulate; stigmas 3.

TYPE: locally frequent in damp sand, Kaieteur Savanna, British Guiana, May 5, 1944, *Maguire & Fanshawe 23244*. New York Botanical Garden. The collectors note: "Leaves erect, spreading, to 10 cm." The species resembles *P. Maguirei* in habit, but is smaller in all its parts.

PAEPALANTHUS LEUCOCYANEUS Tutin. BRITISH GUIANA: in muck, Kaieteur Savannas, *23264*. SURINAM: base of escarpment, Tafelberg, *24750*. The species is known only from British Guiana and Surinam.

Paepalanthus Maguirei Moldenke, sp. nov. Herba caulescens; caulis usque ad 8 cm. longis, simplicibus vel furcatis; foliis graminoideis 2–6 cm. longis, 2–6 mm. latis, subacutis multistriatis utrinque glabris nitidis; vaginis arcte adpressis 2–3.5 cm. longis, glabris, laminis erectis acutis parce ciliatis; pedunculis 5–15, gracilibus, stramineis, 10–21 cm. longis, tricostatis, glabris, complanatis; bracteis involucrantibus oblanceolatis, subacutis vel obtusis brunneis, glabris; bracteis receptaculi anguste obovatis, brunneis, obtusis ad apicem barbatis; floribus trimeris.

Caulescent herb; stems slender, to about 8 cm. long, simple or sparingly branched in furcate fashion, ascending; leaves numerous, crowded, rather uniformly bright green on both surfaces, grass-like, 2–6 cm. long, 2–6 mm. wide at the base, subacute at the apex, many-striate with close paralled veins, not fenestrate, glabrous and shiny on both surfaces; sheaths closely appressed to the peduncle, 2–3.5 cm. long, equaling or slightly shorter than the leaves, obliquely split at the apex, glabrous throughout or with a few scattered cilia on the erect acute blade; peduncles 5–15 per branch, slender, erect, stramineous, 10–21 cm. long, 3-costate, glabrous throughout, flat in drying; heads hemispheric or globose, 4–6 mm. long and wide, gray; involucral bractlets oblanceolate, about 1 mm. long and 0.5 mm. wide, rounded or subacute at the apex, brownish throughout, glabrous; receptacular bractlets narrowly obovate, about 1 mm. long and 0.52 mm. wide, rounded at the apex, brownish and bearded at the apex; staminate florets: sepals 3, broadly obovate, connate only at the very base, about 1 mm. long and 0.54 mm. wide, erect, firm, brown on the upper half, rounded and bearded at the apex, darkest at the apex; petals 3, united into a hyaline glabrous obscurely 3-lobed tube; stamens 3, exserted from the petal-tube; anthers 4-celled; pistillate florets: sepals 3, connate only at the very base, obovate, about 2.6 mm. long and 0.7 mm. wide, erect, firm, brownish toward the apex, translucent toward the base, densely villous on the back at the apex; petals 3, separate to the base, hyaline, narrowly oblanceolate, about 1 mm. long and 0.3 mm. wide, densely long-villous on the back, acute at the apex, eglandular; pistil about 1.3 mm. long; style about 0.6 mm. long, glabrous; stigmas 3; ovary subrotund, about 0.5 mm. long and wide, 3-celled.

TYPE: frequent in cracks in rock of stream bed, North Ridge Cascade, mixed high forest, Savanna I, 15–1700 feet altitude, Tafelberg, Surinam, September 8, 1944, *Maguire 24670*. New York Botanical Garden. Other collections are *Maguire 24241*, locally frequent in wet rocky bed of stream at east side of North Ridge, at top of Tafelberg; and *Maguire 24832*, frequent on moist rocks, North Ridge Creek, km. 25.5, Tafelberg. Related to *P. Killipii* and *P. Tatei* Moldenke.

Paepalanthus pauper Moldenke, sp. nov. Herba parva acaulescens; foliis rosulatis linearibus 7–20 mm. longis, non 1 mm. latis, urtinque glabris; vaginis gracillimis arcte adpressis 1.5–2 cm. longis, glabris, laminis erectis arcte adpressis saepe bilobatis; pedunculis solitariis filiformibus, stramineis,

3–7 cm. longis, glabris vel parce glanduloso-pilosis; bractis involucrantibus ellipticis albidis vel hyalinis acutis glabris nitidis; receptaculo dense longeque villoso; bracteis receptaculi late ellipticis hyalinis convexis obtusis glabris vel ad basin longe villosis; floribus trimeris.

Very small acaulescent herb; leaves rosulate, linear, uniformly light green on both surfaces, 7–20 mm. long, less than 1 mm. wide, glabrous on both surfaces, the venation indiscernible; sheaths very slender, cylindric, closely appressed to the peduncle, surpassing the leaves, 1.5–2 cm. long, obliquely split at the apex, glabrous, the blade erect, closely appressed, often bilobed at the apex; peduncles filiform, usually only one per plant, stramineous, 3–7 cm. long, glabrous or with a few scattered widely divergent gland-tipped hairs about 0.5 mm. long toward the apex; heads white, hemispheric, 1–3 mm. wide, few-flowered; involucral bractlets elliptic, whitish or hyaline, about 2 mm. long and 1 mm. wide, acute at the apex, glabrous and shiny; receptacle densely long-villous; receptacular bractlets broadly elliptic, hyaline, convex on the back, about 1.8 mm. long and 1 mm. wide, blunt at the apex, glabrous throughout or long-villous at the very base; staminate florets: sepals 3, connate only at the very base, hyaline, obovate or oblanceolate, about 1.5 mm. long and 0.5 mm. wide, obtuse or emarginate at the apex, glabrous, eglandular, not bearded; petals 3, united into a very slender hyaline infundibular tube, separate and involute at the apex, glabrous; stamens 3, slightly exserted from the corolla-tube; anthers 4-celled; pistillate florets: sepals 3, separate or connate only at the very base, hyaline, narrow-elliptic, about 1.5 mm. long and 0.5 mm. wide, subacute at the apex, loosely villous on the back especially along the margins, not bearded; petals 3, separate, hyaline, oblanceolate, ca. 1 mm. long and 0.3 mm. wide, densely long-villous on the back, not bearded; pistil about 1 mm. long, glabrous; ovary 3-celled, 3-ovulate.

TYPE: locally frequent in sedge bog, Kaieteur Savanna, British Guiana, May 4, 1944, *Maguire & Fanshawe 23206*. New York Botanical Garden. The collectors describe it as a "minute perennial tufted herb 1–2 cm. high; flower spike to 4 cm. high."

PAEPALANTHUS SUBTILIS Miq. BRITISH GUIANA: in white sand of clearing, Kangaruma, *23000*. SURINAM: frequent in sandy soil of open places, islands in Brokoboto Rapids, 3 hours above Pakka Pakka, *23984*. Southern Venezuela, British Guiana, and Surinam to Bahia, Brazil.

Paepalanthus tafelbergensis Moldenke, sp. nov. Herba caulescens; caulis 1–4 cm. longis ad apicem foliatis; foliis graminoideis erectis vel recurvatis 3–6 cm. longis, 2–8 mm. latis, acutis vel submucronulatis multinervatis utrinque glabris; vaginis gracilibus 1.5–3 cm. longis, laxis, glabris, laminis erectis argute acutis vel submucronulato-acuminatis saepe subrecurvatis; pedunculis 12–60 gracilibus 8–22 cm. longis 4-costatis glabris; bracteis involucrantibus late oblongis atrobrunneis vel nigris glabris, ad apicem triangulari-acutis et longe ciliatis; receptaculo dense longeque villoso; bracteis receptaculi oblanceolatis atrobrunneis vel nigris acutis, ad apicem longe ciliatis et dense barbatis; floribus trimeris.

Caulescent herb; stems greatly abbreviated, 1–4 cm. long, leafy only at the apex; leaves grass-like, comparatively few, erect or recurved, 3–6 cm. long, 2–8 mm. wide at the base, acute or submucronulate at the apex, often mostly dried up at time of anthesis, sometimes with a slightly silvery sheen,

many-nerved, not fenestrate, glabrous on both surfaces; sheaths slender, 1.5–3 cm. long, rather loosely enveloping the peduncle, equaling or surpassing the leaves, glabrous, obliquely split at the apex, the blade erect, sharply acute or submucronulate-acuminate, the tip often slightly recurved; peduncles numerous, 12–60 or more per plant, erect, slender, 8–22 cm. long, about 4-costate, glabrous, slightly twisted; heads gray, hemispheric or subglobose, 4–6 mm. wide, densely hairy; involucral bractlets numerous, closely overlapping in several series, broadly oblong, about 2 mm. long and 1 mm. wide, dark brown or black except at the very base, abruptly triangular-acute at the apex, glabrous and shiny on both surfaces except for the long-ciliate apical triangle; receptacle densely long-villous; receptacular bractlets oblanceolate, about 1.5 mm. long and 0.5 mm. wide, dark brown or black throughout, acute at the apex, glabrous on both surfaces except for the long-ciliate and densely bearded apex; staminate florets numerous: sepals 3, connate only at the very base, obovate or oblanceolate, about 1 mm. long and 0.3 mm. wide, dark brown or black except at the connate base, convex on the back toward the apex, rounded at the apex, glabrous on both surfaces except for the densely bearded apex, the hairs stellate-divergent; petals 3, united into a brownish or stramineous slender tube about 1 mm. long, glabrous, free and involute at the apex, eglandular; stamens 3, slightly exserted; pistillate florets few: sepals 3, connate only at the very base, firm, rigid, elliptic, about 1.3 mm. long and 0.5 mm. wide, rounded at the apex, dark brown or black throughout, flat, glabrous on the inner surface, long-villous on the back from below the middle to the densely bearded apex; petals 3, connate only at the very base, rigid, dark brown or black throughout, narrow-elliptic, about 1 mm. long and 0.25 mm. wide, sharply acute or subacuminate at the apex, glabrous on the inner face, densely long-villous on the back from the base to the apex, eglandular; pistil about 1.5 mm. long, glabrous; stigmas 3; ovary 3-celled, 3-ovulate.

TYPE: frequent in sphagnum border of seeps, bed rock, Savanna VIII, Tafelberg, Surinam, August 25, 1944, *Maguire 24485*. New York Botanical Garden.

PAEPALANTHUS VISCOSUS Moldenke. SURINAM: savanna, Zanderij II, *23665;* in sand, south savanna, vicinity Arawak village of Mata, *24979*. Known only from Surinam.

SYNGONANTHUS BIFORMIS (N.E.Br.) Gleason. SURINAM: on banks of Augustus Creek, Tafelberg, *24728*. Known only from Vaupes, Colombia, British Guiana, and Surinam.

SYNGONANTHUS GRACILIS (Körn.) Ruhl. BRITISH GUIANA: in sandy bog, Kaieteur Savanna, *23180, 23181;* in damp sand, Kaieteur Savanna, *23245;* in muck, Kaieteur Savanna, *23246*. SURINAM: frequent, savanna, Zanderij II, *23691;* infrequent, Savanna I, Tafelberg, *24206*. The species in its typical form is known from Colombia, British Guiana, Surinam, and Brazil. The material cited above and in herbaria under this name is very variable in many characters and may not all be properly identified. Floral characters taken from *23691* and *24206* are as follows: involucral bractlets elliptic or elliptic-obovate, about 2 mm. long and 1 mm. wide, very convex on the back, firm but transparent except for the stramineous base, sharply acute at the apex, glabrous except for the slightly ciliate margins at about the middle; receptacle densely long-villous; receptacular bractlets none; staminate florets long-stipitate: sepals 3, hyaline, about 1.4 mm. long and 0.5 mm. wide,

falcate, acute at the apex, glabrous, eglandular; petals 3, connate into a short slender tube much shorter than the sepals; stamens 3; anthers white, 4-celled; pistillate florets short-stipitate: sepals 3, hyaline, elliptic, about 2 mm. long and 0.7 mm. wide, acute at the apex, eglandular, long-villous on both surfaces; petals 3, connate into a slender hyaline tube, about 1 mm. long, the free tips small and involute, long-hirsute on the back and especially so toward the apex; pistil small; ovary about 0.5 mm. long; style about 0.5 mm. long, glabrous, with 3 tiny erect appendages; stigmas 3, simple.

Syngonanthus guianensis Moldenke, sp. nov. Herba parva caulescens; caulis gracilibus furcatis, ramis 1–3 cm. longis dense foliatis; foliis linearibus late divergentibus vel reflexis 3–15 mm. longis, usque ad 1 mm. latis, obtusis, juventute dense longeque villosis, senectute glabrescentibus, revolutis vel subconduplicatis; vaginis gracilibus ca. 1 cm. longis arcte adpressis plusminus longe villosis, laminis erectis vel divergentibus anguste lanceolatis ad marginem longe pilosis; pedunculis 6–20 gracillimis 2-costatis villosis; bracteis involucrantibus late spathulatis brunneis convexis rotundatis glabris; receptaculo longe villoso; bracteis receptaculi obovatis convexis brunneis obtusis barbatis; floribus trimeris.

Small caulescent herb to about 8 cm. tall; stems slender, branched, the branches 1–3 cm. long, densely leafy; leaves linear, widely divergent or reflexed, 3–15 mm. long, 1 mm. or less wide at the base, the lowest ones on each stem or branch much smaller than the upper ones, blunt at the apex, densely long-villous when young, more sparsely so in age or glabrescent, firm-textured, mostly more or less revolute-margined above the base sometimes almost conduplicate toward the apex, the venation not discernible; sheaths slender, twisted, striate, about 1 cm. long, closely enveloping the peduncle, more or less long-villous with scattered white hairs, noticeably humped at the mouth and prolonged on one side into an erect or divergent, slender, blunt-tipped, narrow-lanceolate blade which is more or less long-pilose along the margins; peduncles very slender, erect, 6–20 per branch, 2-costate, slightly twisted, more or less densely villous with long white appressed or somewhat divergent hairs; heads white, hemispheric, 1.5–4 mm. wide; involucral bractlets broadly spatulate, brown throughout, about 1.5 mm. long and 1 mm. wide, rounded at the apex, somewhat convex on the back, glabrous on both surfaces, not bearded; receptacle long-villous; receptacular bractlets obovate, very convex on the back, about 1 mm. long and 0.7 mm. wide, brown throughout, rounded at the apex, glabrous on both surfaces except for the densely bearded apex; staminate florets numerous: sepals 3, connate only at the very base, erect, rigid, dark brown except at the very base, oblanceolate, about 1 mm. long and 0.26 mm. wide, rounded at the apex, glabrous on both surfaces, not bearded; petals 3, united into a slender stramineous glabrous tube about 0.9 mm. long, the lobes linear, erect, firm, about 0.2 mm. long, not involute; stamens 3, slightly exserted; pistillate florets: sepals 3, connate only at the very base, narrow-elliptic, stramineous or subhyaline, about 1 mm. long and 0.3 mm. wide, subacute at the apex, glabrous throughout, not bearded; petals 3, stramineous or light brown, free at the base and apex, connate at the middle into a slender tube, glabrous, eglandular; ovary 3-celled, glabrous.

TYPE: Kaieteur Savanna, British Guiana, May 4, 1944, *Maguire & Fanshawe 23236*. New York Botanical Garden. Another collection from the same locality is *Maguire & Fanshawe 23182*, described as locally frequent, annual,

short-stemmed herb with canescent leaves. The species superficially greatly resembles *Blastocaulon rupestre* (Gardn.) Ruhl. of Minas Geraes, Brazil.

Syngonanthus savannarum Moldenke, sp. nov. Herba parva caulescens; caulis 3–7 cm. longis valde furcatis dense foliatis; foliis linearibus rigidis recurvatis ca. 1 cm. longis, usque ad 1 mm. latis, ad basin et marginem juventute plusminus dense albido-villosis, senectute glabrescentibus nitidis; vaginis gracilibus ca. 7 mm. longis arcte adpressis plusminus villosulis vel glabratis, laminis firmis erectis acutis, ad basin dense villoso-marginatis; pedunculis gracilibus 3–5 cm. longis villosulis; bracteis involucrantibus arcte imbricatis obovatis brunneis convexis obtusis glabris nitidis; receptaculo dense villoso; bracteis receptaculi oblongis stramineis acutis, versus apicem longe villosis; floribus trimeris.

Small caulescent herb, perennial, growing in tufts to 20 cm. in diameter, to 10 cm. tall; stems conspicuous, 3–7 cm. long, several-branched in dichotomous fashion from the base, densely and equally foliose throughout; leaves linear, firm and rigid, recurved, bright green on both surfaces, about 1 cm. long, 1 mm. or less wide, ampliate and clasping the stem at base, glabrous and shiny on both surfaces or more or less densely white-villous at the base and along the margins when young, blunt at the apex, the venation not discernible; sheaths slender, about 7 mm. long, not plainly costate nor twisted, closely enveloping the peduncle, glabrate below or more or less villosulous with scattered hairs, obliquely split at the apex and usually densely villous-margined there, the blade firm, erect, acute; peduncles slender, one or several per branch, borne in axils considerably below the apex, 3–5 cm. long, densely villosulous when young with long white more or less appressed hairs, less so in age; heads grayish-brown, hemispheric, 2–6 mm. wide; involucral bractlets in several series, closely overlapping, the outermost much smaller than the inner, obovate, brown throughout, very convex on the back, the largest about 1.5 mm. long and 1 mm. wide, rounded at the apex, glabrous and shiny on both surfaces; receptacle densely villous; receptacular bractlets oblong, stramineous, about 1.5 mm. long and 0.5 mm. wide, with hyaline margins, acute at the apex, very densely long-villous at and near the apex; staminate florets numerous: sepals 3, erect, connate only at the base, firm, brown throughout, oblanceolate, 1.3–1.5 mm. long, about 0.4 mm. wide, acute at the apex, glabrous on both surfaces, eglandular, not bearded; petals 3, united into a slender stramineous or subhyaline tube about 1.3 mm. long, glabrous, free at the apex, the lobes erect, hyaline, about 0.5 mm. long; stamens 3; pistillate florets few: sepals 3, connate only at the base, hyaline, narrow-elliptic, about 1.5 mm. long and 0.3 mm. wide, acute at the apex, glabrous on both surfaces, not bearded, eglandular; petals 3, connate at the middle into a slender tube, glabrous; pistil about 1.6 mm. long, glabrous; stigmas 3; ovary very small, glabrous, 3-celled.

TYPE: locally frequent on damp sand, Kaieteur Savanna, British Guiana, May 6, 1944, *Maguire & Fanshawe 23280*. New York Botanical Garden. The species has much of the general aspect of *Paepalanthus Glaziovii* Ruhl. of Minas Geraes, Brazil.

SYNGONANTHUS SIMPLEX (Miq.) Ruhl. BRITISH GUIANA: in sedge bog, Kaieteur Savanna, *23219; 23206a*. Venezuela, British Guiana, and Surinam.

Syngonanthus surinamensis Moldenke, sp. nov. Herba caulescens; caulis 1–7 cm. longis simplicibus dense arachnoideo-pubescentibus dense foliatis; foliis linearibus divergentibus vel reflexis 2–5 cm. longis, usque ad

1 mm. latis, argute acutis vel mucronulatis utrinque glabris; vaginis gracillimis arcte adpressis 4–4.5 cm. longis costatis glabris, laminis erectis argute acutis; pedunculis 2–7 gracillimis stramineis 18–25 cm. longis tricostatis glabris nitidis vel ad apicem adpresso-pilosis; capitulis albis perspicue proliferatis; bracteis involucrantibus ellipticis vel obovatis stramineis vel versus apicem hyalinis convexis subacutis vel obtusis utrinque glabris; receptaculo dense longeque villoso; bracteis receptaculi nullis; floribus trimeris.

Caulescent herb; stems 1–7 cm. long, simple, ascending, densely arachnoid-pubescent with white matted hairs, most conspicuous on the youngest parts, densely foliose; leaves linear, uniformly bright green on both surfaces, divergent or eventually reflexed, 2–5 cm. long, 1 mm. or less wide, slightly ampliate at the base, with a prominulent midrib, sharply acute or mucronulate at the apex, glabrous on both surfaces, not fenestrate; sheaths very slender, closely enveloping the peduncle, usually somewhat surpassing the leaves, 4–4.5 cm. long, twisted, several-costate, glabrous, obliquely split at the apex, the blade erect, sharply acute, not divergent; peduncles 2–7 per plant, very slender, stramineous, 18–25 cm. long, 3-costate, glabrous and shiny except at the obscurely appressed-pilose apex; heads white, hemispheric, 4–6 mm. wide, mostly more or less proliferating with a varying number of reduced leaves 7–15 mm. long or abbreviated leafy matted arachnoid stems to 1 cm. long; involucral bractlets elliptic or obovate, stramineous toward the base, otherwise hyaline, very convex on the back, about 1.5 mm. long, 0.5–1 mm. wide, rounded or subacute at the apex, glabrous on both surfaces, not bearded; receptacle densely long-villous; receptacular bractlets absent; staminate florets: sepals 3, free, hyaline, elliptic, about 1.5 mm. long and 0.5 mm. wide, subacute at the apex, glabrous on both surfaces, not bearded, usually much surpassed by the corolla; petals 3, united into a slender infundibular tube 1–1.8 mm. long, free at the apex, the lobes erect, hyaline, broadly elliptic, about 1 mm. long; stamens 3; anthers white, 4-locular; pistillate florets: sepals 3, free, hyaline, narrow-elliptic, about 2 mm. long and 0.5 mm. wide, subacute at the apex, glabrous on both surfaces, not bearded; petals 3, hyaline, about 2 mm. long, glabrous, united at the middle into a tube about 1 mm. long, free at the apex, eglandular, not bearded; pistil about 1.5 mm. long, glabrous; ovary very small.

TYPE: locally frequent on wet dripping cliffs 200 meters west of Grace Falls, Tafelberg, Surinam, August 26, 1944, *Maguire 24502*. New York Botanical Garden. Another collection is *Maguire 24321*, locally frequent, with long peduncles, under heavy drip, opening high bush, base of north escarpment, 300 meters, Tafelberg.

SYNGONANTHUS TRICOSTATUS Gleason. BRITISH GUIANA: in sedge bog, Kaieteur Plateau, *23113*. British Guiana and Southern Venezuela.

SYNGONANTHUS UMBELLATUS (Lam.) Ruhl. BRITISH GUIANA: in damp sand, Kaieteur Savanna, *23252*. SURINAM: in wet places, Tafelberg, *24380;* common in moist sand along railroad near Km. 70, *23645;* frequent, grass savanna, Zanderij II, *23662*. The species in this typical form is distributed from Vaupes, Colombia, Venezuela, and the Guianas to Minas Geraes, Brazil.

TONINA FLUVIATILIS Aubl. SURINAM: in ditch, savanna, vicinity of Sectie O, km. 68, *25025*. Nicaragua, Cuba, Trinidad, and from Colombia, Venezuela, and the Guianas to eastern Peru and central Brazil.

RAPATEACEAE

CEPHALOSTEMON AFFINIS Koernicke. SURINAM: infrequent, shallow bogs, periphery Savanna I, Tafelberg, *24204;* frequent; wet places, Savanna IV, Tafelberg, *24370.* Previously known only from the type locality, Esmeralda, Venezuela.

POTAROPHYTUM RIPARIUM Sandwith. BRITISH GUIANA: flowers yellow, heads mucilaginous, stems sigmoid in cross-section at base, locally frequent, boggy places along stream, vicinity Potaro River landing, Kaieteur Plateau, *23396.* Known only from the type locality.

RAPATEA PALUDOSA Aubl. var. **paludosa** Maguire, var. nov. *R. paludosa* Aubl. Pl. Gui. **1**: 305, *pl. 118.* 1775. BRITISH GUIANA: perennial herb to 2 m. high, occasional, swampy ground, Amatuk Portage, Potaro River Gorge, *23016;* flower yellow, stem base sigmoid in cross-section, marshy area by stream, Tukeit, Potaro River Gorge, *23546.* SURINAM: frequent, swampy bush east of savanna, Zanderij I, *25044.* Swamp herbs of low altitudes, Venezuela and Colombia to Pará and Amazonas.

RAPATEA PALUDOSA Aubl. var. **sessiliflora** Maguire, var. nov. A var. *paludosa* similis, sed foliis angustioribus; bracteis angustioribus, floribus plus-minus sessilibus.

Similar to the var. *paludosa* but with leaves 1.0–2.5 (3.5) cm. wide, bracts 2.0–2.5 (3.2) cm. wide, and flowers essentially sessile.

TYPE: common, wet, open, dakama bush, Grace Creek, 1 mile east of Savanna VIII, Tafelberg, Surinam, September 1, 1944, *Maguire 24587.* New York Botanical Garden. Cotype: dakama forest, vicinity Black Water Camp (5), Coppenam River Headwaters, 106 meters altitude, July 26, 1944, *Maguire 24177*, at the base of Tafelberg, frequent and occurring to the exclusion of the broad-leaved form; one further collection seen belongs here, viz.; in vicinibus Barra [Manaos], Prov. Rio Nigro [Brazil], Dec.—Mart. 1850–51. *R. Spruce.*

The var. *sessiliflora* is certainly a part of *R. paludosa,* differing only qualitatively in width of leaves, 1.0–2.5 (3.5) as against (3.5) 4.0–9.0 cm., and in width of bracts, 2.0–2.5 (3.2) cm. as against (3.0) 4.0–6.0 cm. in the var. *paludosa.* The most conspicuous difference lies in the length of pedicels, which in var. *sessiliflora* are sessile, subsessile, or occasionally as much as 3 mm. long, while in the typical variety they vary from 5–12 (20) mm. long. Further, the var. *paludosa* is characteristically a plant of low altitude, boggy or swampy areas, while on Tafelberg the entire, generally distributed population consists exclusively of the narrow-leave variant.

R. linearis Gleason apparently is derived from *R. paludosa,* and is superficially similar to the var. *sessiliflora,* but differs essentially in more narrow, gradually attenuate, less prominently nerved sepals.

RAPATEA XIPHOIDES Sandwith. BRITISH GUIANA: locally frequent, boggy places, Kaieteur Plateau, *23297.* Known only from the type locality.

SAXO-FRIDERICIA REGALIS Schomb. BRITISH GUIANA: common, damp sand or sphagnum, borders of bush islands, Kaieteur Savanna, *23330.* SURINAM: flowers yellow, inflorescence and base of stems copiously gelatinous, frequent, border of *Clusia* bush, Savanna VIII, Tafelberg, *24571.* Previously known only from the Mt. Roraima and Kaieteur Plateau regions.

SPATHANTHUS JENMANI N. E. Brown. BRITISH GUIANA: locally common on white sand, wet places, secondary forest, Amatuk Portage, Potaro River,

23015; same data as for preceding, *23547*. Apparently endemic and limited to Amatuk and Warratuk Falls, Potaro River.

SPATHANTHUS UNILATERALIS Desv. SURINAM: frequent, swampy bush, Zanderij II, *23703*; frequent, swamps, vicinity Kwatta hede, Saramacca River, *23917*. Generally distributed: British Guiana, Surinam, French Guiana, Pará, and Amazonas.

STEGIOLEPIS ANGUSTATA Gleason. BRITISH GUIANA: frequent, boggy places in sand or sphagnum, border bush islands, Kaieteur Savanna, *23261*. Known only from the Kaieteur Plateau.

STEGIOLEPIS FERRUGINEA Bakerm. BRITISH GUIANA: frequent, wet places, Kaieteur Savanna, *23320*. Known only from the Kurupung Mountains, and the Kaieteur Plateau, British Guiana.

BROMELIACEAE[30]

Since my publication of "The Bromeliaceae of British Guiana" (Contr. Gray Herb. **89**: 46–86. 1930.) I have seen very little material from any of the Guianas until the present collection came to me. Originally I followed Mez's sequence of tribes or subfamilies, but have changed to Harm's as better expressing the lines of evolution within the family.

Subfamily I. Pitcairnioideae (including Navioideae)

LINDMANIA GUIANENSIS (Beer) Mez. BRITISH GUIANA: perennial bulbous herb 1.6 m. high, basal leaves recurved, flowers white, Kaieteur Plateau, *23158*. The type was collected by Schomburgk on the upper Corentyne River and until now was the only material known.

NAVIA ANGUSTIFOLIA (Bak.) Mez. BRITISH GUIANA: light green leaves, fruit bodies usually lateral, occasionally terminal, from dry rock shelf, 1 mile below Kaieteur Falls, Potaro River Gorge, *23435*. Sandwith (*1285*) col-

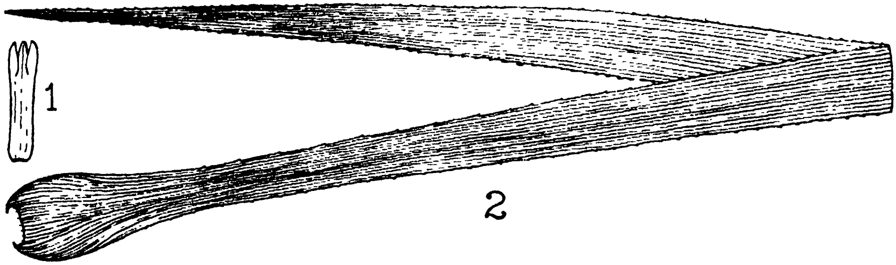

FIG. 14. *Navia Maguirei* L. B. Smith. *Maguire 24575*. 1. sepals. × 1. 2. leaf. × 1.

lected it at the head of the falls. The type was collected by Appun at Mt. Marima (Maringma of later maps) just east of Roraima.

Navia Maguirei L. B. Smith, sp. nov. Fig. 14. Herba caulescens, caulibus ramosis, 22 cm. vel. ultra longis; folia dense polystiche ordinata, margine sparse serrulata et sparsissima lepidota, mox omnino glabra, vaginis ovatis, brevibus, laminis linearibus, acuminatis, ad 25 cm. longis, 9.5 mm. latis, basi angustatis; inflorescentia dense angusteque ovoidea, acuta, per anthesin in

[30] By Lyman B. Smith.

foliorum centro nidulans sed mox ramo sympodialiter superata, 8–9 mm. diametro, glabra, bracteis primariis lineari-laminatis, inflorescentiam plerumque superantibus, bracteis florigeris anguste ovatis, acutis, sepala paulo superantibus; flores sessiles; sepala alte connata, 16 mm. longa, laminis ellipticis, acutis, 4.5 mm. longis, anteriori plana a posterioribus carinatis inclusa; petala alba, quam sepala 7–8 mm. longiora, stamina verisimiliter subaequantia sed recurvata, apice involuto-subulata; ovarium omnino superum.

TYPE: north of Savanna VIII, Tafelberg, Surinam, August 29, 1944, *Maguire 24575*. For habitat see Geogr. Rev. **35**: 574, fig. 11 (1945). In its subpetiolate leaves and highly connate sepals it closely resembles *Navia Gleasonii*, the nearest species to it geographically, but these leaves are serrulate throughout where those of *N. Gleasonii* are nearly entire with only a few teeth at the base of the blade.

NAVIA MAGUIREI var. **minor** L. B. Smith, var. nov. Differt in partibus omnibus minora; caulis brevis, 6–10 cm. longus; folia infra 20 cm. longa et 5 mm. lata; sepala 10 mm longa.

TYPE: common, wet or dry walls, or on soil beneath north escarpment, Tafelberg, Surinam, August 11, 1944, *Maguire 24334*. According to Maguire, the difference in size between this and the typical variety is constant and striking, but there is no difference in the form of the parts that would warrant specific segregation.

BROCCHINIA REDUCTA Bak. (Contr. Gray Herb. **89**: 61). BRITISH GUIANA: perennial herb with woody rootstock, sheathing leaves hollow-cylindroid, fruit greenish-yellow, dominant locally on savannas, Kaieteur Plateau, *23198*. This material from at least the same general region as the type accords very closely with it in its very slender scape (ca. 2 mm.), small remote scape-bracts, and short few-branched inflorescence.

BROCCHINIA MICRANTHA (Bak.) Mez. (Contr. Gray Herb. **89**: 62). BRITISH GUIANA: abundant, dominant, fleshy perennial, stem to 2 m., 15 cm. diam., leaves crowded at apex, floral shoot 2.6 m., branches to 1 m. long, inflorescence pale cream, flowers brownish, Kaieteur Savanna, *23300*. Also from the type region and the first material of the species we have had in the United States. The collection is very ample and makes helpful comparison with later species like *B. Tatei* (Contr. Gray Herb. **161**: 29), and the notes[31] indicate a considerably larger plant in all its parts than has been recorded heretofore.

PITCAIRNIA NUDA Bak. (Contr. Gray Herb. **89**: 64). SURINAM: common, rocks, Savanna VIII, Tafelberg, *24460*. Previously known only from south-central British Guiana, the type, *Appun 1582*, from Rapunnunie (Rupununi River), *A. C. Smith 3644*, from the Kanuku Mountains through which the Rupununi flows, and the upper Tapanahoni River, Surinam. Smith records the flowering plants as 2 m. high.

PITCAIRNIA MAIDIFOLIA (Morr.) Dcne. (Contr. Gray Herb. **89**: 64, under *P. Funckiana*). BRITISH GUIANA: occasional, terrestrial to 1.5 m. high, bracts scarlet, apically green, flowers pale greenish, Kaieteur Savanna, *23411*. SURINAM: frequent, south escarpment, Arrowhead Basin, Tafelberg, *24509*.

[31] Indeed, this striking giant bromeliad may, in its stem and crown of leaves alone, well exceed 6 or 7 meters in height. It, perhaps more than any other plant, dominates the vegetation of the Kaieteur escarpment, and certainly more vividly than any other impresses itself on the mind of the visitor to this spectacular region. B. M.

Also known from Venezuela, Colombia, and Costa Rica. In cultivation for almost a century.

Subfamily II. Tillandsioideae

?TILLANDSIA TRITICEA Burchell (Contr. Gray Herb. **89**: 25, 73). BRITISH GUIANA: frequent, epiphytic, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22822*, material too fragmentary for certain determination. Brazil to Peru, Trinidad and Colombia.

TILLANDSIA BULBOSA Hook. (Contr. Gray Herb. **89**: 74). BRITISH GUIANA: occasional, from *Sapodilla* tree, river tidal flats, Mazaruni Forest Station, *23580*. Widely distributed in British Guiana and elsewhere in tropical America at low elevations.

VRIESIA SPLENDENS (Brongn.) Lem. *V. longibracteata* (Bak.) Mez. (Contr. Gray Herb. **89**: 68). BRITISH GUIANA: frequent, leaves zebroid, alternate bands of red-brown and green, bracts scarlet, Kaieteur Savannas, *23331*. Surinam: frequent, terrestrial, leaves purple-brown barred, talus base of Arrowhead Basin, Tafelberg, *24482*. One of the showiest of bromeliads, in cultivation for a century; French Guiana. According to Maguire, the bracts in a single colony show all gradations from scarlet to green, thus removing from *V. longibracteata* its chief claim to distinction.

VRIESIA VIRIDIFLORA (Regel) Wittm. ex Mez (Lilloa **6**: 405). BRITISH GUIANA: frequent, leaves bronze, Kaieteur Savanna, *23332*. North Western District, Costa Rica.

VRIESIA PROCERA (Mart.) Wittm. (Contr. Gray Herb. **89**: 69). BRITISH GUIANA: common, on a *Sapodilla* tree, flowers yellow, bracts yellow-green, part suffused red, river tidal flats, Mazaruni Forest Station, *23579*. Demerara, Surinam, eastern Brazil.

GUZMANIA ALTSONII L. B. Smith. (Contr. Gray Herb. **89**: 7). BRITISH GUIANA: frequent, terrestrial, to 1 m. high, bracts green, red-margined, from wallaba forest, Kaieteur Savanna, *23410*. SURINAM: frequent, terrestrial, moist high and open bush, northeast of Savanna II, Tafelberg, *24404*. First collections since the type, which was from Kaieteur Plateau. Add information as follows: leaves over 8 dm. long, 5 cm. wide, capsule cylindric, 3 cm. long, coma red-brown.

CATOPSIS BERTERONIANA (Schult.) Mez. (Contr. Gray Herb. **89**: 70). BRITISH GUIANA: occasional, epiphytic on low tree, fruit yellow-green, Kaieteur Savanna, *23265*. Essequibo, southern Florida, Central America, West Indies, eastern Brazil.

Subfamily III. Bromelioideae

ARAEOCOCCUS MICRANTHUS Brongn. (Contr. Gray Herb. **89**: 53). BRITISH GUIANA: frequent, epiphyte, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22884*. SURINAM: epiphyte, ants' nest, tree overhanging Tafelberg Creek, Saramacca River Headwaters, *24901*. General throughout the Guianas, Trinidad, Tobago, Amazon Basin.

AECHMEA MERTENSII (Meyer) Schult. *Ae. mucroniflora* Hook. (Contr. Gray Herb. **89**: 57). BRITISH GUIANA: frequent, mora forests, Kamuni Creek, Groete Creek, Essequibo River, *22824*. General in the Guianas, Trinidad, Amazon Basin.

AECHMEA BROMELIAEFOLIA (Rudge) Bak. (Contr. Gray Herb. **89**: 59). SURINAM: dense wet transition low-high bush north of Savanna II, Tafel-

berg, *24276*. General in the Guianas, British Honduras and Guatemala, Colombia, Venezuela, Trinidad, eastern Brazil, Bolivia, northeastern Argentina.

COMMELINACEAE

ATHYROCARPUS RUFIPES (Seub.) Standl. SURINAM: a specimen without data, but presumably collected at the base of Tafelberg. Apparently unreported from the Guianas; forests, Central America to Brazil and Peru.

DICHORISANDRA HEXANDRA (Aubl.) Kuntze. BRITISH GUIANA: stoloniferous, creeping, ascendent, flowers blue, rare under high mixed forest, Kaieteur Gorge, *23521;* procumbent fleshy herb, gregarious on rocks with species of fern and *Costus;* leaves thinly fleshy, basally sheathing; flowers in bracteate capitula on long axillary peduncles, white, scarcely opening, Takutu Creek to Puruni River, Mazaruni River, *F2084*. SURINAM: flowers deep blue, fruit deep red, frequent, second growth jungle, Charlesburg Rift, 3 km. north Paramaribo, *22788;* petals deep blue with white bases, fruit purple, frequent, edge of forest, Jacob kondre, Saramacca River, *23889;* buds bright red-purple, flowers bicolored, violet and white, frequent, scandent on branches overhanging Tafelberg Creek, Saramacca River Headwaters, *24898*. Widely distributed in tropical America.

TRADESCANTIA GENICULATA Jacq. BRITISH GUIANA: procumbent herb, riverside, Mabaruma, Aruka River, N.W.D., *F2389*. SURINAM: flowers white, common in primary jungle, Charlesburg Rift, 3 km. north Paramaribo, *22804*. Widely distributed in tropical America from Mexico to the West Indies, Brazil, and Peru.

THURNIACEAE

THURNIA SPHAEROCEPHALA (Rudge) Hook. f. BRITISH GUIANA: occasional, bog in secondary forest, Amatuk Portage, Potaro River, *23014;* flowers green, in spherical heads, occasional, sandy stream bed, Kaieteur Savanna, *23298;* locally frequent, Warratuk Portage, Potaro River, *23540;* Amatuk Portage, Potaro River, *23544*. SURINAM: in shallow running water, Krappa Camp (2), Saramacca River Headwaters, *24885*. British Guiana, northern Brazil.

LILIACEAE[32]

SMILAX CUMANENSIS H.B.K. SURINAM: infrequent unarmed vine, flower greenish or purple, white striped within, fruit blue, river bank, vicinity Saron Creek, Saramacca River, *23770, 23772*. West Indies, Venezuela, Colombia, Peru, Guiana. Frequent throughout Surinam.

SMILAX sp. SURINAM: frequent vine, leaves coriaceous, flowers greenish, low bush, big savanna, table top, near North Escarpment, Tafelberg, *24184;* frequent, vine, flowers greenish, in shrubs, Savanna II, Tafelberg, *24254*. Nearly allied to *S. cumanensis*, but with narrow, coriaceous leaves.

SMILAX SCHOMBURGKIANA Kunth. SURINAM: infrequent, fruit red, river banks vicinity Jacob kondre, Saramacca River, *23830*. Throughout Surinam, but apparently less common than *S. cumanensis;* Guiana.

SMILAX KUNTHII Killip & Morton (*S. floribunda* Kunth.). SURINAM: frequent, climbing to 10 m., precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24551*. Mountains of Costa Rica, Peru, and Bolivia. In Surinam also collected on the Hendrik top.

[32] By G. J. H. Amshoff. Preliminary report.

SMILAX sp. SURINAM: frequent, drier places, base of North Escarpment, Tafelberg, *24319;* frequent, fruit red, low bush 1.5 km. west of Savanna IV, Tafelberg, *24411;* frequent, inflorescence reddish, ♂ flower reddish, medium bush, 1.5 km. south of East Ridge, *24591.* First collection in Surinam. To be compared with *S. cuspidata* Poir. from French Guiana.

SMILAX sp. BRITISH GUIANA: occasional vine, fruit globose, green, smooth, red when ripe, Kaieteur Plateau, *23299.* This species has been collected in British Guiana (*Sandwith 1571; F.D. 4007*), and in Surinam (in the Brownsberg forest reserve). It is very distinct because of its accrescent vaginal sheaths and may be identical with the insufficiently known *S. syphilitica* Willd. (Orinoco River), the only species in which this feature is described.

HAEMODORACEAE[33]

XIPHIDIUM COERULEUM Aubl. SURINAM: frequent, dense bush along stream and trail near Jacob kondre, Saramacca River, *23870;* frequent, primary jungle near Posoegronoe, Saramacca River, *24027;* cultivated, Agricultural Experiment Station, Paramaribo, *22768.* West Indies, tropical South America; common throughout Surinam.

DIOSCOREAE[34]

DIOSCOREA AMAZONUM Griseb. SURINAM: frequent, vine, flowers purple, in rather open savanna bush, along railroad near Km. 70, *23616.* Guiana, Amazonian district; frequent throughout Surinam.

DIOSCOREA TRICHANTHERA Gleason. BRITISH GUIANA: occasional, vine from *Aniba excelsa,* flowers in axillary pendent spikes, yellow-brown, in wallaba forest, Kaieteur Plateau, *23238.* Known only from British Guiana.

DIOSCOREA POLYGONOIDES Humb. & Bonpl. BRITISH GUIANA: rocky lateritic soil from dolerite dyke, Garraway Stream, Potato River, *22987a.* Central America, West Indies, tropical South America; frequent.

MUSACEAE[35]

HELICONIA ACUMINATA L. C. Rich. BRITISH GUIANA: perennial, bracts keeled, scarlet, flowers green, locally frequent, Kaieteur Savanna, *23322.* SURINAM: bracts red, flowers green, fruit blue, frequent, shaded low wet bush, river banks above Kwatta hede, Saramacca River, *23949;* bracts red, frequent, northeast of Savanna II, Tafelberg, *24406.* Venezuela, Guiana, Amazonian district. Common in Guiana.

HELICONIA sp. (cf. *H. Psittacorum* L.f.). BRITISH GUIANA: perennial herb to 3 m. high, pedicels long-sheathed, inflorescence and keeled bracts pruinose, flowers orange, rocky lateritic soil, Garroway Stream, Potaro River, *22970.*

ZINGIBERACEAE[36]

COSTUS CYLINDRICUS Jacq. SURINAM: perennial, stems spiraling, bracts red, frequent, border of forest, Kwatta hede, Saramacca River, *23926.*

[33] By G. J. H. Amshoff.
[34] By G. J. H. Amshoff.
[35] By G. J. H. Amshoff. Preliminary report.
[36] By G. J. H. Amshoff. Preliminary report.

RENEALMIA OCCIDENTALIS (Sw.) Sweet. BRITISH GUIANA: to 2 m., occasional, swampy area, mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22834*. SURINAM: infrequent, pina swamp, vicinity camp no. 3, Saramacca River, *24149*. West Indies, Venezuela, Colombia, Guiana.

RENEALMIA PEDICELLARIS Gleason. SURINAM: inflorescence prostrate, spreading from base, arils orange, frequent, primary jungle, near village of Posoegronoe, *24022*. The same species has been collected by Tulleken, no. 464(L), along the upper Nickerie River. Known otherwise only by the type, *Gleason 138,* Tunatumari, and *Gleason 626,* Rockstone, both from British Guiana.

RENEALMIA MONOSPERMA Miq. SURINAM: fruit red, rare, grass savanna, Zanderij II, *23704;* infrequent, pina swamp, vicinity camp no. 3, Saramacca River, *24147*. This species, in our herbarium represented by the type, *Kegel 1470,* only, has been consequently neglected by monographers. It has to be compared with *R. humilis* Peters. The fruit is 1-seeded, (in the type), or 3-seeded.

RENEALMIA sp. SURINAM: perennial herb, flowers yellow, reddish base, medium bush, 1.5 km. south of East Ridge, Tafelberg, *24597*. Allied to *R. chrysotricha* Petersen. The same species has been collected on the Hendrik top at 1080 m. (*B. W. 5697*).

MARANTACEAE[37]

CALATHEA CYCLOPHORA Baker. BRITISH GUIANA: frequent, open bush, high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22851;* perennial, leaves crimson below, bracts cyclic, greenish, flowers whitish, occasional, Kaieteur Savannas, *23321*.

CALATHEA ELLIPTICA (Rosc.) K. Schum. SURINAM: common, Charlesburg Rift, primary jungle bordered on both sides by swamps and marshes, 3 km. north of Paramaribo, *22806*. Surinam and British Guiana, frequent.

CALATHEA GRANDIS Peters. SURINAM: flowers cream, frequent, Charlesburg Rift, primary jungle bordered on both sides by swamps and marshes, 3 km. north of Paramaribo, *22805*. Compared with the type specimen, *Wullschlägel 516* (BR), also collected near Paramaribo. A third specimen has been collected by Focke [no. 893, named *C. alluia* (Aubl.) Lindley by Pulle, Enum. 110 (1906)] near Ornamibo. Otherwise, the species is not represented in our Surinam collections and no data about its occurrence in other countries are known to me.

MARANTA ARUNDINACEA L. SURINAM: flowers white, fragile, infrequent, bush to rear of village Jacob kondre, Saramacca River, *23890*. Common throughout the tropics.

MONOTAGMA PARKERI (Roscoe) K. Schum. BRITISH GUIANA: perennial, leaves erect, flowers pale pink, occasional herb from wallaba forest, Kaieteur Plateau, *23329*. SURINAM: locally common, hill, mixed wallaba forest, vicinity Base Camp, Tafelberg Creek, *24118;* flowers white, lower lip pink, frequent, swamps, bush near Kwatta hede, Saramacca River, *23918*. Guiana, Peru; frequent in Surinam.

MONOTAGMA GUIANENSE (Koern.) K. Schum. SURINAM: savanna, east side, Zanderij I, *25058*. The specimen quite agrees with *Splitgerber 289* (L.), determined by the monographer K. Schumann as *M. guianense* (Koern.) K.

[37] By G. J. H. Amshoff. Preliminary report.

Schum. It is, however, possibly only a form of *M. plurispicatum* (Koern.) K. Schum., described by K. Schumann in Engler, Das Pflanzenreich IV **48**: 169 (1902) as "maxine affinis." To *M. guianense* (Koern.) K. Schum. also belong *Kappler 1335* and *Wullschlägel 1135* and *520* (BR), cited by Petersen in Martius, Fl. Bras. 3^3: 132, *pl. 34* (1890) under *I. laxum* (P. & E.) Koern., a quite distinct Peruvian species. The Brazilian specimens cited by Petersen belong according to Schumann (l. c.) to *M. plurispicatum* (Koern.) K. Schum.; Schumann has unfortunately not examined the Surinam specimens.

THALIA GENICULATA L. SURINAM: marsh herb to 5 dm., bracts green, broadly purple-tipped, flowers white, frequent in water, coastal jungle, road to Carl Francois along Saramacca River, 40 km. from Paramaribo, *23593*. Tropical and subtropical America and Africa; frequent in Surinam.

ISCHNOSIPHON FOLIACEUS Gleason. BRITISH GUIANA: perennial herb, bracts pale pink, flowers white, occasional, Dicymbe forest, trail from Kaiatuk to Tukeit, *23477*. Endemic.

ISCHNOSIPHON GRACILIS (Rudge) Koern. BRITISH GUIANA: scandent to 10 m. long, branched at each node, flowers pink and yellow, locally common, secondary forest, Kaieteur Plateau, *23323*. Guiana, northern Brazil, Peru.

ISCHNOSIPHON OBLIQUUS (Rudge) Koern. BRITISH GUIANA: openings and thickets, frequent, wet soil, Kamuni Creek, Groete Creek, Essequibo River, *22923*. Guiana, Brazil, Colombia, Peru, Martinique; frequent in Guiana.

BURMANNIACEAE[38]

Tribus Burmannieae

Subtribus *Euburmannieae*

BURMANNIA CAPITATA (J. F. Gmel.) Mart. (69). Slender herb with a capitate inflorescence at the apex of the usually unbranched stem, flowers wingless, mostly white or pale cream. BRITISH GUIANA: on wet sand, rare, *23283*. SURINAM: grass savanna, Zanderij II, *23681;* savanna, frequent, Zanderij I, *23723;* rare, Savanna I, Tafelberg, *24205*. A common American species, known from the Southern United States to Bolivia and Paraguay. As discussed by Sprague in Kew Bull. **1939**: 331, the correct citation of author names is: (J. F. Gmel.) Mart., and not: (Walt.) Mart. as cited in my monograph.

BURMANNIA BICOLOR Mart. (89). Unbranched herb with 1–6, blue, violet, or white, often yellow-tipped, prominently 3-winged flowers at the apex of the stem. BRITISH GUIANA: rare, moist sand, Kaieteur Plateau, *23282*. SURINAM: grass savanna, Zanderij II, *23680;* wet places, frequent, Savanna II, Tafelberg, *24227;* frequent, northern part of Savanna IV, Tafelberg, *24371*. Known from Cuba, Venezuela, Guiana, and Brazil.

BURMANNIA TENELLA Benth. (77). BRITISH GUIANA: delicate colorless saprophyte from leaf mold, flowers white, prominently 3-winged, inflorescence 1–7-flowered, forming bifid concinnus, ovary markedly triangular, Kaietuma River, 12 miles up, *F2409*. Bolivia, Brazil (Amazonas and Matto Grosso), Venezuela, and British Guiana.

[38] By F. P. Jonker. Ref.: Meded. Bot. Mus. & Herb. Utrecht **51**. 1938.

Subtribus *Apterieae*

APTERIA APHYLLA (Nutt.) Barnh. var. HYMENANTHERA (Miq.) Jonk. (35, 207). Erect, simple or branched herb with inclination toward nodding, usually blue campanulate flowers, stamens inserted in crescent-shaped sacs, filaments with two broad rounded wings. SURINAM: frequent in sandy soil of montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24132;* damp place under log, low bush west of Savanna IV, Tafelberg, *24410.* The species occurs from the southern United States to Brazil and Bolivia. This small-flowered variety takes the place completely of the species in Guiana and the southern West Indian Islands; also, together with the species in Brazil and some other West Indian Islands.

DICTYOSTEGA OROBANCHIOIDES (Hook.) Miers var. PARVIFLORA (Benth.) Jonk. (38, 218). Erect herb with a simple stem, forked at the apex, inflorescence a loose double concinnus, flowers small, white, anthers subsessile, not inserted in sacs. SURINAM: frequent in damp floor of low bush, 1 km. south of Savanna I, Tafelberg, *24362.* The species occurs from southern Mexico to southern Brazil, Bolivia, and Peru. This small-flowered variety takes the place completely of the species in Surinam, French Guiana, and Amazonian Brazil; also, together with the species in Trinidad, British Guiana, Venezuela, and Colombia.

GYMNOSIPHON FIMBRIATUS (Benth.) Urb. (187). Stem up to 15 cm. high, rather thick, beset with ovate, acute scales, bearing at the apex a capituliform inflorescence, surrounded by rather large ovate bracts, perianth whitish, the upper third part of the outer perianth lobes beset with a fringe, arranged in two convergent lines and at the margin, at the top a long forked fringe. The present collection showed only one complete flower, of which the fringe was remarkably short and thick, perhaps broken. The forked fringe was missing here. For the first time, deflorated flowers of this species were collected. They showed, in contradistinction to the presumption in my Monograph, that the limb is always deciduous after flowering; the persistent part of the perianth being to 4.5 mm. long. BRITISH GUIANA: frequent on moist loam, mora bush, Kamuni Creek, Groete Creek, Essequibo River, *22811.* This is the first record for British Guiana. The species was twice collected by Spruce in Amazonian Brazil.

GYMNOSIPHON GUIANENSIS Gleason (187). Up to 33 cm. high, herb with a usually simple stem, forked into two, mostly rich-flowered concinnus-arms, pedicels to 3 mm. long, flowers erect, white, limb deciduous, capsule subglobose. BRITISH GUIANA: frequent in mora bush, Kamuni Creek, Groete Creek, Essequibo River, *22815;* locally frequent on white sand, in swampy mixed forest, Waratuk Falls, Potaro River Gorge, *23032.* Recorded from British Guiana only.

ORCHIDACEAE[39]

The following summary of the Orchidaceae collected in British Guiana and Surinam in 1944 includes many species not heretofore recorded from those regions, as well as several concepts which appear to be entirely new. Altogether, therefore, this study which I have been privileged to make shows that primitive sections of the American tropics afford a constant source of surprises.

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[39] By Charles Schweinfurth.

The order of genera followed is that proposed by Dr. Rudolf Schlechter, Das System der Orchidaceen, Notizbl. Bot. Gart. & Mus. Berlin-Dahlem **9**: 563–591. 1926.

HABENARIA LEPRIEURII Reichb. f. Linnaea **19**: 376. 1847. A very slender species up to nearly 6 dm. high, with few linear-subulate leaves and a commonly few-flowered lax raceme of minute greenish flowers often variegated with white or yellowish. BRITISH GUIANA: rare terrestrial in sphagnum bog, Kaieteur Plateau, *23288*. Recorded from Trinidad, French Guiana (unlocalized) and Brazil.

VANILLA POMPONA Schiede. Linnaea **4**: 573. 1829. An elongate, mostly stout vine, climbing over shrubs and trees; leaves large, varying from ovate to ovate-oblong or oblong-elliptic, acute or acuminate, 14–30 cm. long; racemes axillary, more or less short, stout, with congested flowers; flowers very large (probably the largest in the genus), lasting for a day, white or yellowish (rarely greenish) with yellow or orange on the lip; perianth tubular-campanulate, about 8–9 cm. long; lip with a scaly appendage but without warty excrescences; fruit trigonous-cylindric, stout, formerly an important source of Vanilla extract. BRITISH GUIANA: rare, in mixed forest, trail from Tukeit to Kaieteur Plateau, *23091*. (The leaves are abnormally narrow in this collection.) Mexico through Central America to Panama, and northern South America to Peru and Brazil.

VANILLA WRIGHTII Reichb. f. Flora **48**: 273. 1865. A slender, elongate vine, climbing over shrubs and low bushes; leaves small, ovate to oblong-elliptic, acute or short-acuminate, with a rounded or subcordate base, usually about 7.5 cm. or less long; racemes axillary, short, slender, few-flowered, loose; flowers about 5–6 cm. long, greenish-yellow to fawn-colored with a white lip which is entirely smooth; fruit very slender, linear-cylindric. BRITISH GUIANA: Kaieteur Plateau, *23176*. SURINAM: frequent in Savanna II, Tafelberg, *24258* (fruit). The West Indies from Jamaica to Trinidad and British Guiana and Surinam.

EPISTEPHIUM sp. aff. *E. parviflorum* Lindl. (flowers poor). Plant erect, slender, about 3 dm. high; leaves on the upper part of the stem, elliptic-oblong, acute or acuminate, short-petioled, up to 8.5 cm. long; racemes short, few-flowered, axillary and terminal, shorter than the leaves; flowers small, pink, about 2.2 cm. long, rather imperfect; ovary to almost 3 cm. long, slender, cylindric, crowned by a plurilobulate cup (as in the genus). SURINAM: terrestrial, in low bush between Savannas II and III, Tafelberg, *24255*. (The abbreviated inflorescences point to a new species.)

ELLEANTHUS LINIFOLIUS Presl, Rel. Haenk. 97. 1827. Plant very slender, up to 40 cm. tall (rarely taller); stems more or less densely caespitose, filiform, leafy; leaves very narrowly linear, acute or sharply tridentate, strict or erect-spreading, up to 10 cm. long; spikes terminal, short (often suborbicular), laterally flattened, distichously few- to many-flowered; flowers minute, white, mostly concealed by the imbricating bracts; lip much broader than the other segments, broadly obovate, concave, saccate at the base, rounded in front. BRITISH GUIANA: rare epiphyte on *Caryocar microcarpum*, along Potaro River above Kaiatuk, *23368;* rare epiphyte, along Potaro River below Tukeit, *23512*. SURINAM: frequent epiphyte in high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24523*. Also reported from Mexico through Central America to Panama, the West Indies, and most of South America to Brazil and Peru.

SOBRALIA sp. (fruit). Plant tall, stout; leaves elliptic or ovate-elliptic, 19 cm. or more long; fruit about 9.5 cm. long, terminal, cylindric, plurisulcate. SURINAM: frequent on open rocks and in thickets, flowers white, Savanna VIII, Tafelberg, *24434a*.

SOBRALIA sp. (flower agglutinated). Plant rather stout, somewhat branched; leaves (on upper part of stem) lanceolate to elliptic-lanceolate, acuminate, up to 11.5 cm. long; inflorescences axillary, abbreviated, 1-flowered; flower rather large, about 6 cm. long, campanulate, mauve. BRITISH GUIANA: rare, to 2 m. high, straggling habit, beneath low tree, Kaieteur Plateau, *23380*.

SOBRALIA sp. aff. *S. sessilis* Batem. (flower agglutinated). Plant rather tall; leaves up to 20.5 cm. long, elliptic or oblong-elliptic; flower terminal, rather large. SURINAM: frequent terrestrial, flowers white, lip bronze to purple within, in low bush, Savannas II and III, Tafelberg, *24262*.

SOBRALIA LILIASTRUM Lindl. Gen. & Sp. Orch. Pl. 177. 1833; 432. 1840. Plant tall, 2–3 m. high, erect; stem rather stout, leafy; leaves lanceolate or narrowly lanceolate, long-acuminate, 20 cm. or less long; raceme terminal, loosely up to 11-flowered, with a fractiflex rachis; flowers large, white or rose-colored with yellow on the frilled lip; sepals up to 6.5 cm. long. BRITISH GUIANA: locally common terrestrial, Kaieteur Plateau, *23419*. Also recorded from Venezuela and Brazil.

WULLSCHLAEGELIA CALCARATA Benth. Journ. Linn. Soc. **18**: 342. 1881. Plant very slender, leafless; stem to about 5.6 dm. long, suberect and more or less arcuate or flexuous below, minutely hairy throughout; raceme terminal, short to elongate, rather densely many-flowered; flowers minute, with a prominent rather narrow spur-like sac. BRITISH GUIANA: frequent, on floor of mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22921*. Also recorded from French Guiana, Trinidad and Brazil.

ERYTHRODES SANTENSIS (Kränzl.) C. Schweinf. Bot. Mus. Leafl. Harvard Univ. **9**: 128. 1941. *Physurus santensis* Kränzl. in Svensk. Vet.-Akad. Handl. **46**: 39, *pl. 7, f. 6.* 1911. Plant low, with the lower part of the stem apparently prostrate and rooting, the upper part erect, about 15–20 cm. tall; leaves 3–5, on upper portion of stem, lanceolate to lanceolate-elliptic, acute or acuminate, narrowed to a loose tubular amplexicaul petiole, lamina up to 7 cm. long; spike terminal, short, rather densely few- (6- to 15-) flowered, up to 4.5 cm. long; flowers rather small, white; petals cuneate-flabellate, obliquely bilobed above; lip spurred, with a prominent retrorsely lunate apical lobe which is reversed in natural position and presents two linear forcipate lobes. SURINAM: rare epiphyte on moss-covered tree, 2 km. south of East Ridge, Tafelberg, *24593*. Also Colombia and Brazil.

STELIS ARGENTATA Lindl. Bot. Reg. **28**: Misc. 64, No. 78, 1842. Plant very medium-sized for the genus, caespitose, up to about 30 cm. high; stems relatively short, up to 6.6 cm. long, 1-leaved at the summit; leaf linear-oblong to elliptic-oblong, obtuse to rounded with a tridenticulate apex, long-narrowed below to a short petiole, up to 13 cm. long; raceme solitary, commonly much surpassing the leaves, loosely many-flowered, about 20 cm. or less long; flowers small, greenish-purple or green and rose-color; sepals subequal, connate below, densely silvery-pubescent within; petals and lip minute, truncate. BRITISH GUIANA: epiphyte on *Eperua*, in wallaba forest, Takutu Creek to Puruni River, Mazaruni River, *F2102*. Also French Guiana and Venezuela.

STELIS DROSOPHILA Rodr. Gen. & Sp. Orch. Nov. **2**: 88. 1882. Plant very small, caespitose, slender, 5–10 cm. high; stems up to 2 cm. tall, 1-leaved at the apex; leaf linear-oblanceolate, up to 5.5 cm. long; raceme solitary, commonly rather longer than the leaf; flowers very minute, greenish-white or cream-color; sepals subequal, basally connate, petals and lip much smaller. BRITISH GUIANA: locally frequent epiphyte, Kaieteur Plateau, *23338*.

PLEUROTHALLIS BLAISDELLII S. Wats. Proc. Am. Acad. **23**: 284. 1888. Plant small, caespitose, rarely up to 16 cm. high; stems unifoliate, up to 10 cm. long, entirely enveloped by close tubular sheaths with ovate spreading hispid mouths; leaf solitary, erect, oblong-elliptic or elliptic, up to 6.5 cm. long; racemes terminal, solitary or several, much shorter than the leaf, densely several-flowered; flowers very small, dull purple-brown to red (rarely lavender or greenish); segments ciliolate. BRITISH GUIANA: occasional epiphyte, Kaieteur Plateau, *23445* (flowers immature, buds). Also Mexico through Central America south to Panama.

PLEUROTHALLIS GROBYI Batem. ex Lindl. Bot. Reg. **21**: *pl. 1797*. 1836; Bot. Reg. **21**: *pl. 1825* (as *P. picta* Lindl.). Plant small, slender, caespitose, about 11 (rarely 15) cm. or less high; stems very short, 1-leaved at the apex; leaf variable, obovate (rarely suborbicular) to spatulate or very narrowly oblanceolate, obtuse (rarely acute) to rounded and minutely retuse at the apex, long-narrowed below to a petioled base, up to 6.5 cm. long; raceme terminal, solitary, commonly about twice as long as the leaf or more, loosely few- to many-flowered; flowers small, greenish or yellow (rarely white or lavender), often lined with red; sepals ovate-lanceolate or triangular-lanceolate (dorsal) to ovate-lanceolate or oblong-lanceolate (laterals), sharply acute to acuminate, the lateral sepals connate nearly to the apex, concave; petals much smaller, obliquely cuneate-oblanceolate; lip similarly small, ligulate to narrowly oblong. BRITISH GUIANA: epiphyte on Greenheart tree, Takutu Creek to Puruni River, Mazaruni River, *F2131*. Also Mexico, through Central America to Panama, Cuba, and South America to Brazil and Peru.

PLEUROTHALLIS HITCHCOCKII Ames. Orch. **7**: 117. 1922. Plant medium-sized, up to 22 cm. high, caespitose; stems relatively slender, 1-leaved at the summit, up to 13.5 cm. high; leaf erect, elliptic or oblong-elliptic, obtuse, cuneate below, abruptly contracted to a slender petiole, up to 8.5 cm. long; inflorescences abbreviated, 1-flowered, solitary or fascicled, partly concealed by a prominent conduplicate spathe; flowers greenish cream-color, relatively large; sepals lanceolate, long-acuminate, concave, the lateral sepals connate below; petals much shorter, linear-lanceolate, with a single short tooth below; lip slightly longer than the petals, rhombic-ovate, 3-lobed near the base; lateral lobes small, falcate-oblong, incurved and overlapping the mid-lobe; mid-lobe much larger, ovate. BRITISH GUIANA: epiphyte on Greenheart tree, Takutu Creek to Puruni River, Mazaruni River, *F2134*. Apparently endemic.

PLEUROTHALLIS LEPTOPETALA Cogn; Urban, Symb. Antill. **6**: 693. 1910. Plant slender, caespitose, up to 20 cm. high; stems filiform, variable in size, 12.5 cm. or less long, unifoliate at the apex; leaf linear to oblong-elliptic, erect or spreading, sessile, up to 8.8 cm. long; peduncles abbreviated, several, 1-flowered; flowers small, yellowish (rarely whitish); free sepals 2, ringent, ovate; petals linear; lip ovate. SURINAM: frequent epiphyte, high forest,

base of south escarpment at 625 m. altitude, Arrowhead Basin, Tafelberg, *24525*. Also Trinidad and Venezuela.

PLEUROTHALLIS RUSCIFOLIA (Jacq.) R. Br.; Aiton, Hort. Kew. ed. 2, **5**: 211. 1813. The type of this large genus. *Epidendrum ruscifolium* Jacq. Select. Stirp. Am. 226, *pl. 133, f. 3.* 1763. Plant variable, small to medium-sized, up to 39 (rarely 55) cm. high; stems caespitose, commonly numerous, slender, 1-leaved at the apex, about 25 (rarely 38) cm. or less long; leaf erect (rarely spreading), oblong-elliptic (rarely elliptic, linear-elliptic or lanceolate), acuminate, short-petioled, about 13 cm. or less long; peduncles abbreviated, numerous, 1-flowered, surrounded by a concave spathe; flowers small, white, greenish or cream-colored to yellowish; free sepals 2, ringent, concave, lanceolate or lanceolate-ovate, long-acuminate; petals linear, lip ovate. SURINAM: frequent epiphyte, high forest at 625 m. altitude, base of south escarpment, Arrowhead Basin, Tafelberg, *24524* (no flowers). A common and widespread species, extending from Guatemala to Panama, the West Indies and South America to Bolivia and Peru.

PLEUROTHALLIS STENOPETALA Lodd. ex Lindl. Bot. Reg. **24**: Misc. 95, no. 182. 1838. Plant small to medium-sized, up to 40 cm. high, extremely variable both vegetatively and florally; stems slender, caespitose, unifoliate at the apex, up to 13.5 cm. high; leaf obovate-oblong to oblong or oblong-elliptic, rounded (rarely subacute) at the apex, short-petioled; lamina up to 9.5 cm. long; raceme terminal, solitary, much surpassing the leaf, rather densely many-flowered; flowers small to medium-sized, secund, whitish-green to yellow; sepals oblong-linear to linear, acute, more or less pubescent within; petals and lip much smaller. BRITISH GUIANA: rare epiphyte, Kaieteur Plateau, *23102*. Widely distributed in northern South America.

OCTOMERIA BREVIFOLIA Cogn.; Mart. Fl. Bras. **3**[4]: 643, *pl. 133, f. 2.* 1896. Plant small and very slender, up to 19 cm. high; stems filiform, caespitose, unifoliate at the apex, up to 15.5 cm. long; leaf relatively short or very short, subterete, channelled, acute or acuminate; peduncles solitary or two, abbreviated, 1-flowered; flower small, with spreading membranaceous segments; sepals and petals similar, lanceolate or oblong-lanceolate; lip much shorter, sharply 3-lobed near the base with small triangular lateral lobes. SURINAM: epiphyte, abnormally long leaves 4.5–6.5 cm. long, in high bush, east border of Savanna IV, Tafelberg, *24379*. Also British Guiana and Brazil.

OCTOMERIA EXIGUA C. Schweinf. var. **elata** C. Schweinf. var. nov. Herba caulibus et foliis multo longioribus et labelli lobo terminali abrupte acuto a specie differt.

Plant small, caespitose; stems slender, entirely concealed by several imbricating tubular sheaths, unifoliate at the apex, mostly 4–7 cm. long; leaf erect, linear, minutely tridenticulate at the obtuse apex, 2.7 (rarely)–5.5 cm. long (including the short petiole), up to 3.5 mm. wide; peduncles abbreviated, 1-flowered, 2 to numerous; flowers very small, pale lemon-yellow, membranaceous; dorsal sepal oblong-lanceolate, acute, concave, 3-nerved, about 3.8 mm. long and 1.8 mm. wide; lateral sepals very similar but a little smaller; petals similar to the sepals but smaller; lip much shorter than the other segments, rhombic-obovate, about 1.5 mm. long, lightly 3-lobed in front with the lobules subequal, the lateral lobes being rounded and the mid-lobe triangular and acute.

TYPE: Occasional epiphyte, Kaieteur Plateau, British Guiana, May 5, 1944, *Maguire & Fanshawe 23256*. New York Botanical Garden; isotype in Ames Herbarium No. *63079*.

Malaxis Maguirei C. Schweinf. sp. nov. Figure 15. Herba terrestris, pro genere mediocris. Caulis basi leviter dilatatus. Folia duo, e plantae parte inferiore patentia, ovata vel oblongo-ovata, acuta. Pedunculus longus, tenuis. Racemus congestus, umbelliformis. Flores numerosi, late patentes, minimi. Sepalum dorsale ovatum vel elliptico-ovatum, obtusum, convexum. Sepala lateralia simillima, paulo angustiora. Petala lanceolato-linearia, abrupte acuta vel retusa. Labellum in circuitu subquadratum, apice trilobatum, basi breviter biauriculatum. Columna generis.

Plant terrestrial, about 21.5 cm. tall from the base of the plant to the tip of the flower cluster; stem lightly dilated near the base, entirely enclosed by the tubular sheathing base of the leaves and with one or two shorter outer sheaths, about 5 cm. high; leaves two, subopposite, spreading, the blades ovate or oblong-ovate, acute, clasping at base, 6–7 cm. long, 3–4 cm. wide; peduncle long, slender, about 13 cm. high, plurisulcate; raceme congested, umbelliform; floral bracts crowded, very short, ovate, acute; flowers minute, numerous, on widely spreading filiform pedicels which are about 1.5 cm. long; perianth segments widely spreading; dorsal sepal ovate or elliptic-ovate, obtuse, convex, 3-nerved, about 3 mm. long and 2 mm. wide when expanded; lateral sepals very similar but slightly narrower; petals lanceolate-linear, retuse, truncate or abruptly acute, about 3 mm. long and 0.8 mm. wide, 1-nerved; lip deeply concave, subquadrate in outline, terminating in three subequal, triangular, subacute lobules of which the middle one is more porrect, shortly biauriculate at the base with obliquely triangular auricles, lightly retuse on each side, about 3.2 mm. long from the apex of the lip to the tip of a basal auricle and 2.2 mm. wide; disc concave below, with a semi-orbicular-ovate fleshy callus just behind the middle apical lobule; column very short and stout.

This species appears to be allied to the Colombian *Malaxis caracasana* (Kl.) O. Ktze., but differs in its broader acute (not acuminate) leaves and in its short auricles of the lip.

TYPE: Grown in the propagating house of the New York Botanical Garden; description from a photograph and notes sent to the author, together with a raceme of flowers preserved in liquid. Tafelberg, Surinam, May 17, 1945, *Maguire 26212*.

EPIDENDRUM IBAGUENSE H.B.K. var. SCHOMBURGKII (Lindl.) C. Schweinf. Bot. Mus. Leafl. Harvard Univ. **11**: 235. 1944. *E. Schomburgkii* Lindl. Bot. Reg. **24**, *pl. 53*. 1838. Plant large and stout, up to 15 dm. or more tall; stems more or less robust, naked below, rather densely distichous-leaved above; leaves oblong to elliptic-oblong, obtuse to rounded above, sessile and semi-amplexicaul, up to 16 cm. long; peduncle terminal, commonly simple, elongate, leafless but enclosed in close tubular scarious sheaths, flower-bearing above; raceme densely or subdensely several- to many-flowered; flowers orange-pink (rarely salmon-pink) to scarlet, with spreading segments; lip adnate to the column to its apex, commonly deeply 3-lobed with a keel extending through the middle. SURINAM: flowers have a very variable lip, in mixed low bush in ants' nest, near west escarpment, Tafelberg, *24695;* epiphyte, in ants' nest, on tree overhanging Tafelberg Creek, Saramacca

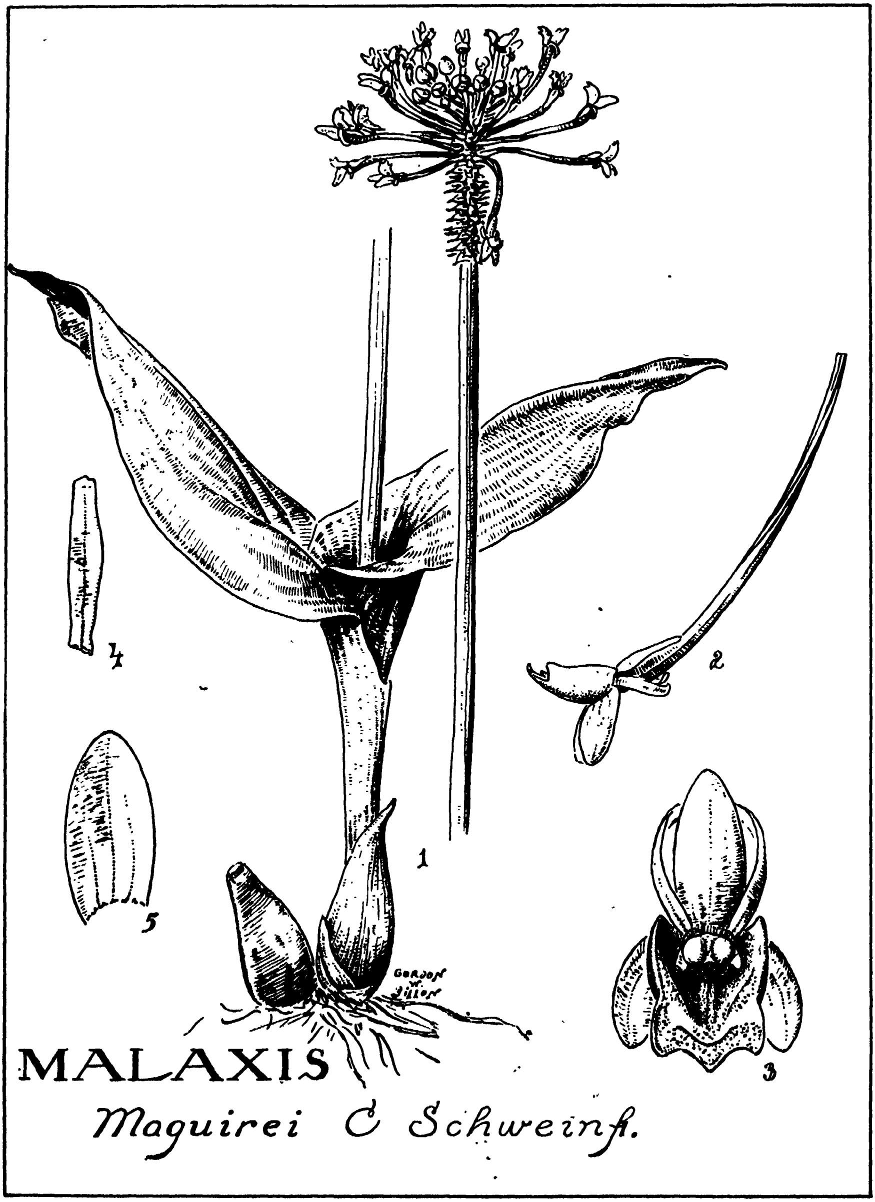

FIG. 15. *Malaxis Maguirei* C. Schweinfurth. *Maguire 26212.*

River Headwaters, *24900* (advanced fruit). Also British Guiana, Trinidad, and Brazil.

EPIDENDRUM IMATOPHYLLUM Lindl. Gen. & Sp. Orch. Pl. 106. 1831. Plant large, rather robust, rarely up to 18 dm. high; stems simple, naked below,

distichously several- to many-leaved above; leaves linear-oblong to oblong (rarely elliptic-oblong), subacute to rounded at the apex, sessile and semi-amplexicaul, rarely up to 18 cm. long; peduncle more or less elongate and concealed by tubular scarious sheaths; inflorescence racemose, sometimes branched, densely (rarely loosely) several- to many-flowered; flowers medium-sized, lavender or rose-color to purple, with spreading segments; petals broader than the sepals; lip adnate to the column up to its apex, simple to obscurely 3-lobed, the lateral lobes (or basal part of lip) more or less lacerate. SURINAM: epiphyte in ants' nest, along Toekoemoetoe Creek, Saramacca River Headwaters, *24916*. Also Mexico and Central America to Brazil and Peru.

Epidendrum latipetalum C. Schweinf. sp. nov. Figure 16. Herba mediocris, terrestris. Pseudobulbus ovoideus, bifoliatus, complanatus. Folia oblonga vel oblanceolato-oblonga, abrupte acuta, inaequalia. Inflorescentia multo altior, laxissime racemosa, pauciflora. Flos mediocris cum segmentis patenti-incurvis. Sepalum dorsale oblanceolatum, acutum. Sepala lateralia similia, oblique elliptico-oblanceolata. Petala obovato-spathulata, sepalis latiora. Labellum columnae basi adnatum, profunde trilobatum; lobi laterales oblique late oblongi, apice crenato rotundato, erecto-incurvi; lobus medius major, suborbiculari-obovatus, marginibus rotundatis undulatisque; discus basi bicarinatus. Columna breviter biauriculata.

Plant medium-sized, terrestrial; roots fibrous, relatively stout, glabrous; pseudobulb complanate-ovoid, bifoliate, about 2.5 cm. high; leaves 2, spreading, very unequal, oblong to oblanceolate-oblong, abruptly acute or subacute, narrowed to a conduplicate base, 12.5–16 cm. long, 2.4–2.7 cm. wide; inflorescence terminal, suberect, about 43.5 cm. high (excluding the apical flower), very loosely racemose above or with an abortive branch below; peduncle rather slender, about 26 cm. long, with four remote short close tubular sheaths; raceme very remotely 4-flowered; floral bracts minute, infundibuliform, acute; flowers rather large, with spreading-incurved subfleshy segments, green suffused with brownish green and lip white striated with mauve, drying blackish; dorsal sepal oblanceolate, acute, about 2.3 cm. long and 9 mm. wide; lateral sepals similar, elliptic-oblanceolate, slightly oblique, acute, about 2.4 cm. long and 8.5 mm. wide; petals obovate-spatulate, slightly oblique, abruptly acute, about 2.2 cm. long and 11.5 mm. wide; lip adnate to the column at the very base, about 1.9 cm. long, deeply 3-lobed; lateral lobes erect and incurved in natural position, porrect, obliquely and broadly oblong, broadly rounded and irregularly crenate at the apex; midlobe much larger, suborbicular-obovate, broadly rounded in front with a minute apicule, cuneate-narrowed below, with recurved margins, about 12.5 mm. long and 10 mm. wide; disc with a pair of thickened approximate ridges below and with many thickened radiating veins above, the anterior margins being undulate and crenate (sometimes lobulate); column rather short and stout, about 12 mm. long, with a pair of suborbicular incurved auricles above; ovary smooth.

There do not appear to be any near allies of this species.

TYPE: rare terrestrial, in shade, Kaieteur Plateau, British Guiana, May 9, 1944, *Maguire & Fanshawe 23327*. New York Botanical Garden.

EPIDENDRUM NOCTURNUM Jacq. Enum. Pl. Carib. 29. 1760; Select. Stirp. Am. 225, *pl. 139*. 1763. Plant very variable and widespread; stems commonly clustered, more or less robust, up to 9 dm. high, leafless below, distichously

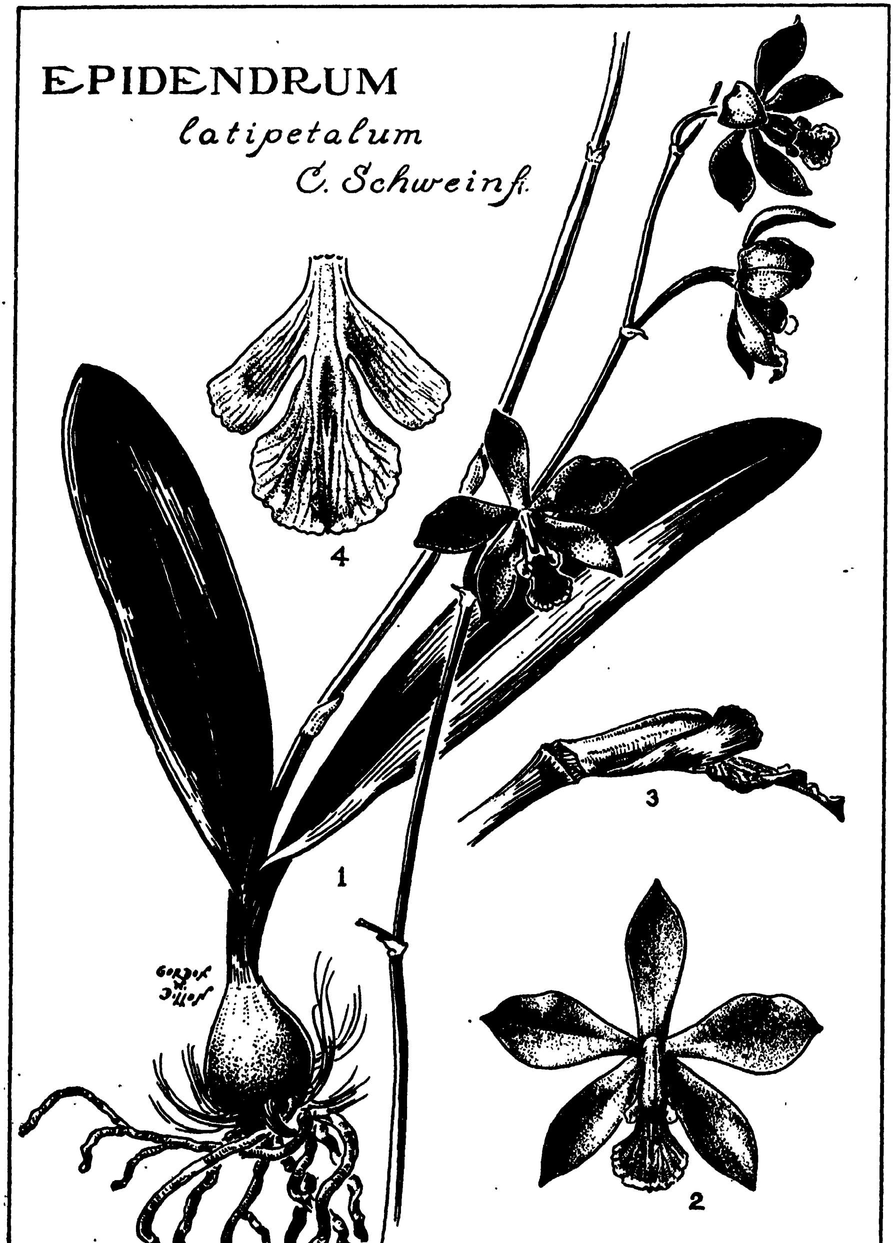

FIG. 16. *Epidendrum latipetalum* C. Schweinfurth. *Maguire & Fanshawe 23327.*

several- to many-leaved above; leaves very narrowly oblong to oval, rounded to subacute at the apex, semiamplexicaul, up to 16 (rarely 18) cm. long; inflorescences terminal, abbreviated, racemose, often several, with commonly but one flower present at a time; flower large, very long-pedicelled, with widespreading segments; sepals and petals similar, linear, acuminate, 3–5 (rarely 7.5) cm. long, white, greenish-white, yellow, reddish-yellow or brown, (rarely tinged with lavender); lip adnate to the column up to its apex, deeply 3-lobed, white turning to yellow; lateral lobes semiovate or aliform; mid-lobe about twice as long, narrowly linear or acicular, long-acuminate. British Guiana: stems only to 10 cm. high, frequent on rocks in dry situations, Kaieteur Plateau, *23173*. Surinam: terrestrial, infrequent, in shallow bogs, Savanna I, Tafelberg, *24217;* frequent on rocks and in thickets, Savanna VIII, Tafelberg, *24431*. Also Florida, Mexico through Central America to Panama and the West Indies to Brazil, Bolivia, and Peru.

Epidendrum oncidioides Lindl. Bot. Reg. **19**: *pl. 1623*. 1833. Plant tall, rather slender, very variable, up to 10 dm. high, from a creeping rhizome; pseudobulbs broadly ovoid to fusiform or cylindric, 2- to 3-leaved near the apex, concealed by scarious sheaths, up to 10 cm. high; leaves elongate, linear, obtuse to acute, up to 60 cm. long, erect or ascending; inflorescence much surpassing the leaves, loosely paniculate (rarely subsimple) above, with short few- to several-flowered branches; flowers medium-sized, with widespreading segments, brown and yellow; sepals oblanceolate or elliptic-lanceolate; petals elliptic-spatulate to round-spatulate, commonly broader than the sepals; lip adnate to the base of the column, deeply 3-lobed, up to 15 mm. long; lateral lobes erect and clasping the column, very oblique, oblong, pandurate or ovate; mid-lobe with a short isthmus, suborbicular-ovate or suborbicular to transversely oval; disc below with two fleshy ridges which extend into fleshy radiating lines above; column stout, with a pair of apical incurved rounded auricles. Surinam: frequent terrestrial, in shallow bogs, Savanna I, Tafelberg, *24216;* Gran dam, Saramacca River, *24928*. Also Mexico to Honduras and northern South America to Brazil.

Epidendrum purpurascens Focke, Tijdschr. Natuurk. Wetensch. **4**: 64. 1851. Plant medium-sized, from a short creeping rhizome; pseudobulbs stipitate, fusiform-clavate, compressed, several-jointed, rarely up to 24 cm. high, 1- or 2-leaved above; leaves linear-elliptic, oblong or oblong-elliptic, acute, cuneate at the sessile base, up to 22.5 cm. long; inflorescence racemose above, equaling or exceeding the leaves, subtended by several imbricating distichous compressed sheaths; raceme loosely few- to several-flowered; flowers small to medium-sized, subtended by large scarious bracts; sepals and petals green, often tinged with purplish on the back; sepals elliptic-linear or elliptic-oblong, with revolute margins; petals similar, narrower; lip adnate to the column up to its apex, deeply 3-lobed, white; lateral lobes obliquely semiovate or aliform, irregularly dentate or lobulate on the outer margins; mid-lobe spatulate or obovate, abruptly dilated above, acute or short-acuminate at the apex; column arcuate above. Surinam: epiphyte, Tafelberg, *26214;* infrequent on rocks in high mixed forest, Schmidt Mountain, km. 7, Saramacca River Headwaters, *24882*. Also Costa Rica and northern South America.

Brassavola sp. (fruit) aff. *B. cucullata* (L.) R. Br. Stems slender, entirely enveloped by loose tubular, scarious sheaths, about 12–18 cm. high,

1-leaved at the apex; leaf linear-terete, up to 27.6 cm. long; ovary ellipsoid, produced into a long slender beak about 8 cm. long. SURINAM: frequent epiphyte, red fruit, river-side en route to Pakka Pakka, Saramacca River, *23959*.

BRASSAVOLA MARTIANA Lindl. Bot. Reg. **22**: sub *pl. 1914*. 1836; **25**, *pl. 5*. 1839. Plant medium-sized to large; stems approximate on a creeping rhizome, entirely enveloped by several elongate tubular scarious sheaths, up to 16 (rarely 25) cm. long, 1-leaved at the apex; leaf linear-terete, longitudinally sulcate, up to 24 (rarely 50) cm. long, more or less curved; inflorescence terminal, much shorter than the leaves, loosely to subdensely few- to many-flowered above; pedicellate ovary slender, elongate, about 7–9 cm. long; flowers medium-sized but small for the genus, with widespreading segments, greenish or white with a white lip; sepals linear-lanceolate, long-acuminate, the lateral ones oblique; petals elliptic-linear; lip shorter but much broader than the other segments, simple, ovate, acuminate, fimbriate or lacerate-dentate; column short, stout. SURINAM: epiphyte, overhanging Tafelberg Creek, Saramacca River Headwaters, *26200*. Also British Guiana and Brazil.

SCAPHYGLOTTIS VIOLACEA Lindl. Bot. Reg. **22**, *pl. 1901*. 1836. Plant slender, sprawling, more or less elongate; stems superposed, often fascicled, each member somewhat swollen in the living plant and 2-leaved at the apex, the lowest ones about 14 cm. or less long; leaves subopposite, linear or oblong-linear, bilobulate at the obtuse apex, sessile, up to 12 (rarely 16) cm. long; flowers terminal, 2 to several, on very short 1-flowered peduncles, very small, rose-purple or violet with white on lip; mentum or chin formed by the lateral sepals prominent; lip ligulate-spatulate, lightly undulate above on each side, callose-thickened in the middle. BRITISH GUIANA: occasional epiphyte, Kaieteur Plateau, *23162;* epiphyte on upper branches of a wallaba and common on other trees, Barabara Creek, 14 miles Bartica-Potaro Road, *F817*. Also Brazil and Peru.

POLYSTACHYA LUTEOLA (Sw.) Hook. Exot. Fl. **2**: *pl. 103*. 1824. *Cranichis luteola* Sw. Fl. Ind. Occ. **3**: 1433. 1804 ? Plant small to medium-sized, variable, up to about 3.6 (rarely 5) dm. high; stems short, approximate, more or less bulbose-thickened at the base, entirely concealed by sheaths which are leaf-bearing above; leaves 2 or more, erect-spreading, elliptic or elliptic-oblong to oblong or oblanceolate-oblong, acute or obtuse, amplexicaul at the narrowed sessile base, up to 25 (rarely 32). cm. long; inflorescence generally exceeding the leaves; peduncle entirely enveloped by tubular scarious sheaths; flower cluster racemose or more commonly loosely paniculate, several- to many-flowered, the branches commonly secund; flowers very small, yellowish or yellowish-green, with a conspicuous chin or mentum; lip 3-lobed in the middle with the lateral lobes small, obliquely semiovate and porrect; disc with a long pubescent callus in the middle. BRITISH GUIANA: frequent epiphyte on *Sapodilla,* river tidal flats, vicinity of Mazaruni Forest Station, *23581*. Florida, Central America from Guatemala to Honduras, the West Indies and northern South America to Brazil, Colombia and Peru. Also Philippines and perhaps other Pacific Islands.

EULOPHIA ALTA (L.) Fawc. & Rendle, Fl. Jam. **1**: 112, *pl. 22, f. 4–8*. 1910. *Limodorum altum* L. Syst. Nat. ed. 12, **2**: 594. 1767. Plant large, up to about 12 dm. high; leaves (commonly appearing after the inflorescence) elliptic-oblong or oblanceolate-oblong, acuminate, 3–7, imbricating at the long-sheathing base, about 8.4 (rarely 11.5) dm. or less long; scape basal, lateral,

much surpassing the leaves, up to 12.7 dm. high; raceme elongate, loosely many-flowered; flowers medium-sized, pinkish, reddish-brown or green with brownish-green or purple lip; petals broader than the sepals; lip deeply concave at the base, lightly 3-lobed above the middle; disc with a pair of short keels and many scattered tubercles. SURINAMS along railroad, Km. 70, *23635*. Florida, Mexico through Central America, to Panama, the West Indies and northern South America to Brazil, Peru, and also West Africa.

CYRTOPODIUM ANDERSONII (Lambert) R. Br.; Aiton, Hort. Kew. ed. 2, **5**: 216. 1813. *Cymbidium Andersonii* Lambert in Andrews' Bot. Repos. **10**: *pl. 651.* 1811. Plant large and showy; pseudobulbs elongate, robust, fusiform or subcylindric, many-jointed, about 6–10 dm. high, the younger ones clothed with the persistent sheaths of the older leaves, many-leaved above; leaves 8–12, elliptic-oblong or narrowly oblong-lanceolate, acute or acuminate, up to 6 dm. long; scape basal, lateral, robust, exceeding the leaves, up to 16 dm. tall, above loosely branched to form a large pyramidal many-flowered panicle; floral bracts large, ovate or ovate-lanceolate, spreading or reflexed, yellow-green; flowers medium-sized, with spreading segments, yellow, the sepals tinged with greenish; sepals oval-ovate not or scarcely undulate; petals broadly obovate; lip clawed, deeply 3-lobed near the middle; lateral lobes obliquely semiorbicular, spreading; mid-lobe broadly obovate-reniform, with a broadly rounded and retuse apex; disc irregularly warty near the apical margin. SURINAM: locally frequent on rocks, Grasi Falls, Saramacca River, *24939*. Widely distributed in South America from British Guiana to Brazil and Uruguay.

MORMODES sp.? (advanced fruit). Plant stout, rather small; pseudobulb cylindric, covered by several scarious imbricating sheaths, about 12 cm. long, with several leaf-sheaths near the apex; no leaves present; scape lateral, basal, strict, 5-jointed, bearing at the summit a large ellipsoid fruit about 4 cm. long, with a short, stout, apparently twisted column. SURINAM: frequent terrestrial, Savanna I, Tafelberg, *21219*.

CATASETUM sp. ♀. Plant stout, about 24 cm. high; pseudobulb oblong-ovoid, about 6 cm. long, mostly concealed by dilated leaf-sheaths; leaves about 7, elliptic, acute or acuminate, up to 18 cm. long, the upper blades mostly tapering to a petiole; scape lateral, basal, shorter than the upper leaves, densely few-flowered at the summit; lip much the largest member of the yellowish flower, entirely deeply saccate, apparently semiglobose. SURINAM: epiphyte, on islands in Brokoboto Rapids, about 3 hours' above Pakka Pakka, Saramacca River, *23994*.

CATASETUM DISCOLOR Lindl. Bot. Reg. **27**: sub *pl. 34.* 1841. *Monachanthus discolor* Lindl. Bot. Reg. **20**: *pl. 1735.* 1835. Plant medium-sized to large; pseudobulb oblong-ovoid to oblong-fusiform, several-jointed, 5–17 cm. long, more or less concealed by the dilated bases of the leaf-sheaths; leaves about 7 or less, deciduous below but congested above, oblong-elliptic (rarely obovate-oblong), acute or short-acuminate, up to 40 cm. long; scape of male flowers lateral, basal, erect or ascending, about 25–65 cm. or more tall, rather loosely 3- to many-flowered above, more or less surpassing the leaves; male flowers small for the genus, nodding, greenish suffused with brown and lip yellowish (rarely purplish) with yellow and purple within; sepals and petals narrow, reflexed, membranaceous; lip uppermost, relatively large, fleshy, semiglobose, lightly 3-lobed in front with the margins fimbriate;

scape of female flowers similar, often shorter, loosely few-flowered; all parts of flower fleshy, larger than the male flowers, the lip being relatively large, entire, deeply saccate. SURINAM: frequent, grass savanna, Zanderij II, *23698, 23699;* common in open rock savannas, Tafelberg, *26210.* Also British Guiana, Brazil, and Venezuela.

CATASETUM PLANICEPS Lindl. Bot. Reg. **29**: *pl. 9.* 1843. Plant large, similar to the other species of the genus; pseudobulbs clustered, oblong-ovoid to subfusiform, many-jointed, 8–22 cm. long, entirely concealed by the dilated bases of the leaf-sheaths when young; leaves about 6–9, elliptic to elliptic-oblong, acute or acuminate, up to 35 cm. long; scapes of the male flowers lateral, basal, erect, shorter or slightly longer than the leaves, about 45 cm. or less high, subdensely about 6-flowered above; flowers medium-sized, yellowish with the lip greenish and yellow-margined; sepals and petals membranaceous, elliptic-oblong or obovate-oblong, acute or apiculate, more or less connivent; petals elliptic, broader; lip much larger than the sepals and petals, fleshy (especially in front), deeply saccate, with the porrect apex triangular-acute and the erect sides broadly rounded and more or less serrate; column with a pair of slender equal antennae. SURINAM: common in open rock savannas, Tafelberg, *26211.* Venezuela, British Guiana, and Brazil.

PERISTERIA PENDULA Hook. Bot. Mag. **63**: *pl. 3479.* 1836. Plant large and showy; pseudobulbs clustered, oblong-ovoid or elongate-conic, lightly compressed, 3- or 4-leaved near the apex, 6.5–15 cm. long; leaves large, elliptic-oblong, acute, gradually petiolate-narrowed below, up to 70 cm. long, convolute; scape lateral, basal, pendent, slightly longer than the pseudobulbs, up to 18 cm. long, above subdensely 4- to 8-flowered; flowers rather large, fleshy; segments subglobose-connivent; sepals oblong-ovate (dorsal) to round-ovate (laterals); petals elliptic-ovate, smaller than the sepals, all whitish-green outside, dull reddish inside with fine purplish spots; lip smaller than the other segments, divided into two parts, whitish or yellowish finely spotted with purple; lower (basal) part with a pair of spreading subquadrate-rounded lobes; upper (anterior) part strongly recurved, ovate-oblong with an erect fleshy keel on each side; column very short and stout, with a pair of oblong porrect auricles. SURINAM: infrequent on rocks in high mixed forest, Schmidt Mountain, Km. 7, Saramacca River Headwaters, *24883.* British Guiana, Brazil and Peru.

Polycycnis surinamensis C. Schweinf. sp. nov. Figure 17. Herba epiphytica, spectabilis. Pseudobulbi aggregati, oblongo-ovoidei vel oblongo-ellipsoidei, subtetragoni ut videtur, unifoliati vel bifoliati. Folium magnum, petiolatum; lamina elliptica vel elliptico-oblonga, acuta, plicata. Inflorescentia lateralis, pendula, supra laxe pluri- vel multiflora. Flores mediocres, lutei, fuscomaculati. Sepalum dorsale concavum, lanceolato-ellipticum, acuminatum, valde reflexum. Sepala lateralia oblique elliptico-lanceolata, quam sepalum dorsale paulo breviora et latiora. Petala anguste linearia. Labellum lanceolato-lineare, dimidio inferiore longe fimbriato, basi callo trilobato libero ornata. Columna gracillima, arcuato-incurva, apice alato-dilatata.

Plant epiphytic, showy; pseudobulbs aggregated, numerous, apparently oblong-ovoid to oblong-ellipsoid and subtetragonous, unifoliate or bifoliate at the apex, about 5 cm. or less long; leaves large, petioled, about 20–39.5 cm. long; lamina elliptic-oblong to elliptic, sharply acute, cuneate at the base, pli-

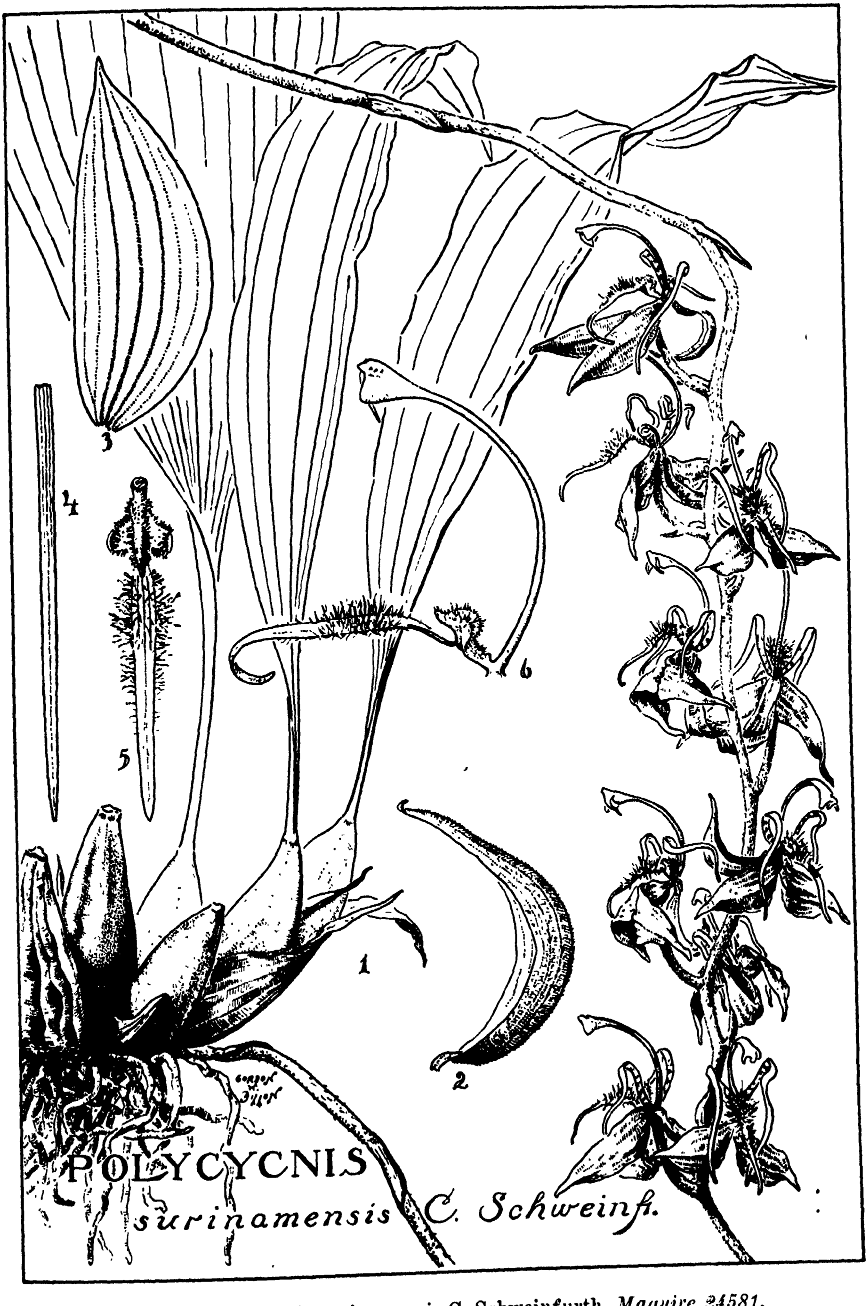

FIG. 17. *Polycycnis surinamensis* C. Schweinfurth. *Maguire 24581.*

cate with 5–7 main ribs, 15–34 cm. long, up to 10.6 cm. wide; petiole about 5–6 cm. long; inflorescence lateral, pendent, laxly several- to many-flowered above, about 40–80 cm. long; peduncle slender, densely purple-pubescent, about 22–30 cm. long, provided at the base with several imbricating short tubular sheaths and above with 4–5 remote larger tubular hirsute sheaths; raceme loosely several- (10-) to many-flowered, about 30–51 cm. long, with rachis densely short-pubescent; floral bracts linear-lanceolate, acuminate, concave, pubescent; flowers medium-sized, with widely spreading segments, yellow spotted with brown; sepals rather densely dark-pubescent without; dorsal sepal concave, lanceolate-elliptic, acuminate, about 3 cm. long, 6.4–8 mm. wide, 7-nerved, strongly reflexed in natural position; lateral sepals obliquely elliptic-lanceolate, acuminate, reflexed, concave, dorsally carinate, 2.5–2.7 cm. long, 8–9.3 mm. wide, 7-nerved; petals narrowly linear, acute, 2.9–3.3 cm. long, about 1 mm. wide, 3-nerved below, apparently strongly reflexed below the middle; lip lanceolate-linear, acute or acuminate, with a complicate tip, about 2.2–2.6 cm. long and 1.8 mm. wide, provided on each side below the middle with numerous long fringes, adorned near the base with an oblong pubescent fleshy callus (with a minute tooth at the base) which merges into a prominent 3-lobed, free, pubescent callus of which the lateral lobes are spreading-upcurved and semiobovate and the mid-lobe is larger, laterally flattened, very fleshy and semielliptic to conic-semiorbicular when viewed from the side; column very slender, arcuate-incurved, about 2.7 cm. long, abruptly dilated at the apex with a pair of obliquely round-ovate porrect wings and a deflexed, linear-triangular, fleshy, rostellar process.

This species is apparently unique within the genus in the characters of the lip.

TYPE: frequent, flowers on the outer surface and lip pale buff spotted with pink-brown, upper petals pale yellow, rostellum green with yellowish tip, in medium bush, 2 km. south of East Ridge, Tafelberg, Surinam, September 1, 1944, *Maguire 24581*. New York Botanical Garden; isotype in Ames Herbarium No. *62927*. Also Venezuela (Cerro Duida).

STANHOPEA GRANDIFLORA (Lodd.) Lindl. Gen. & Sp. Orch. Pl. 158. 1832. *Ceratochilus grandiflorus* Lodd. Bot. Cab. *pl. 1414*. 1828. Plant large and showy; pseudobulbs clustered, conic-ovoid or oblong-ovoid, plurisulcate or corrugated, 1-leaved at the apex, 2.5–7 cm. high; leaf distinctly petioled; lamina oval to elliptic-oblong, acute, cuneate below, up to 40 cm. long; petiole up to 8 cm. long; scape short, pendent, up to 12 cm. long, with several loose or imbricating cucullate sheaths below, 1- or usually 2-flowered above; flowers large to very large, ivory-white often marked with pink or lavender, with spreading or reflexed segments; sepals ovate-oblong (dorsal) to obliquely oval-ovate (laterals), membranaceous; petals linear-oblong to broadly oblong; lip very fleshy, pandurate-oblong in outline; basal portion semiglobose-saccate with a small incurved horn or tooth on each side of a large central cavity; middle part oblong and very thick, sulcate within, slightly dilated above, retuse in front; apical part triangular, convex; column long, slender, arcuate, lightly semielliptic-winged on each side. SURINAM: epiphyte, Tafelberg, *26215*. Also Trinidad, Venezuela, British Guiana, and Brazil.

BIFRENARIA BICORNARIA Reichb. f. Hamb. Gartenz. **19**: 12. 1863. Plant medium-sized; pseudobulbs clustered, ovoid, 4-angled, shining, 1-leaved at the apex, 1.5–4.5 cm. high; leaf petioled; lamina oblanceolate or oblong-

elliptic, acute, cuneate below, 9.5–17.5 cm. long; petiole 2.5–4.5 cm. long; scape lateral, basal, erect, slender, loosely several- (about 5-) flowered above, 25 cm. long; flowers rather small, pale yellow with red-brown spots or bars; sepals elliptic-ovate (dorsal) or obliquely oblong-ovate (laterals), the latter being wider and forming a chin or mentum with the column-foot; petals oblanceolate-elliptic, much narrower than the sepals; lip prominently 3-lobed near the middle, short-clawed; lateral lobes small, retrorse, semielliptic, irregularly crenate-dentate without; mid-lobe much larger, semiorbicular, subtrilobed with undulate-crisped margins; disc with a large warty callus at the base and in front an ovate-subquadrate smooth fleshy callus; anther with 2 lateral horns. SURINAM: dry cliff bases of west escarpment, Tafelberg, *26199*. Also Brazil and Peru.

MAXILLARIA DESVAUXIANA Reichb. f. Bonplandia **3**: 67. 1855. Plant medium-sized; pseudobulbs clustered on a shortly creeping rhizome, rather small, ovoid or pyriform-ovoid, compressed, 3–4.5 cm. long, 1-leaved at the apex, concealed by triangular evanescent sheaths; leaf long-petioled; lamina oblong or elliptic-oblong, acute, shortly cuneate below, up to 35 cm. long; petiole up to 15 cm. long; scape lateral, basal, ascending, shorter than the pseudo-bulb, entirely concealed by several loose, triangular, imbricating sheaths; flower medium-sized; sepals ovate-oblong, acute, apiculate, the laterals forming a short chin or mentum, yellowish-brown or pale bronze; petals obovate-oblong, yellowish-brown with purple mottling; lip smaller than the other segments, ovate or ovate-oblong when spread out, sharply 3-lobed above with the lower part tubular-involute, deep purple; mid-lobe suborbicular or subquadrate, warty-callose on the upper surface. SURINAM: epiphyte in high bush, east of North Ridge, Saramacca River, *24344*. Colombia, French Guiana, and Brazil.

MAXILLARIA VIOLACEO-PUNCTATA Reichb. f. Bonplandia **3**: 216. 1855. Plant large and stout; pseudobulbs often clustered, large, 5.5–10 (rarely 13) cm. high, strongly compressed, oblong-cylindric, 1-leaved at the apex, more or less concealed by 2 pairs of conduplicate leaf-bearing sheaths; leaves broadly oblong to linear-oblong, rounded or subacute at the obliquely bilobed apex, more or less gradually narrowed below to a conduplicate, petiole-like base, up to 69.5 cm. long; scapes few, erect, a little shorter (rarely longer) than the pseudobulb; flower medium-sized to rather large, bright green or cream-color to yellow with violet spots on the lip; sepals oblong (dorsal) to elliptic-oblong (laterals), acute; petals much smaller, obliquely oblanceolate-oblong, acute or acuminate; lip ovate in outline, recurved, more or less sharply 3-lobed above the middle, with the lower part tubular-involute; mid-lobe strongly produced, triangular, much thickened. SURINAM: epiphyte, near White Rock Rapids, between Grasi Falls and Posoegronoe, Saramacca River, *24010*. British Guiana, Brazil and Peru.

IONOPSIS UTRICULARIOIDES (Sw.) Lindl. Coll. Bot. *pl. 39A*. 1825. *Epidendrum utricularioides* Sw. Prodr. Veg. Ind. Occ. 122. 1788. Plant small to large, variable; stems more or less elongate, with solitary or clustered 1-leaved pseudobulbs which are minute to 3 cm. long and surrounded by leaf-bearing sheaths; leaves linear to oblong (sometimes conduplicate and recurved), acute and apiculate, more or less narrowed to a sessile base, rarely up to 16.2 cm. long; scape lateral, basal, much surpassing the leaves, racemose or more commonly spreading-paniculate, several- to many-flowered, about 11–76 cm. high; flowers rather small, white, pale rose or lavender; sepels

small, oblong or ovate-oblong; petals larger, elliptic-oblong; lip about twice as long as the other segments, broadly obcordate, bilobed. BRITISH GUIANA: rare epiphyte on low tree, Kaieteur Plateau, *23100*. Also Florida, Mexico through Central America to Panama, the West Indies and most of South America.

BRASSIA WAGENERI Reichb. f. Bonplandia **2**: 14. 1854. Plant large, pseudobulb large, oblong-ellipsoid or subcylindric, about 9–12 cm. high, 2- to 3-leaved near the apex, provided below with several pairs of imbricating sheaths of which an upper one bears a small leaf; leaves elliptic-oblong, acute, gradually narrowed below to a sessile conduplicate base, about 31 cm. or less long; scape lateral, basal, in the axil of a sheath, slender or stout, about 12.7 dm. or less tall, rather loosely several- (6-) to many-flowered; flowers large, with widespreading segments; sepals linear-lanceolate, setaceous-acuminate, bright green to pale yellow; petals similar but somewhat shorter, blackish-brown below; lip rhombic-obovate, rather abruptly long-acuminate and cuspidate, the lower part narrow and rounded at base, green with brown spots below; disc at base with a pair of low keels, smooth (except at base) and ending with a dilated abrupt tooth. BRITISH GUIANA: rare terrestrial, in shade, Kaieteur Plateau, *23326*. Venezuela and Colombia.

ONCIDIUM PUSILLUM (L.) Reichb. f. Walp. Ann. **6**: 714. 1863. *Epidendrum pusillum* L. Sp. Pl. ed. 2, 1352. 1763. Plant dwarf, variable, epiphytic, up to 8 cm. high; stem obscure or none; leaves several to numerous, equitant, radially spreading to form a flabelliform or suborbicular cluster, imbricating below; blades unjointed, oblong-linear to (rarely) elliptic, more or less oblique, acute or subacute, up to 7.2 cm. long; scapes lateral, axillary, about equaling the leaves, compressed, densely 1- to several-flowered at the apex; flowers yellow, large to very large in relation to the plant, with widespreading, membranaceous segments; dorsal sepal elliptic-ovate or obovate, commonly acute; lateral sepals oblong-lanceolate, acuminate; petals ovate-oblong, larger than the dorsal sepal, commonly obtuse; lip much larger than the other segments, deeply 3-lobed; lateral lobes small, obovate-suborbicular; mid-lobe much larger, ovate-semiorbicular or reniform in outline, abruptly 4-lobed in front; disc at base with a several-lobed flat callus. BRITISH GUIANA: rare, Kaieteur Plateau, *23099*. Mexico through Central America to Panama, Trinidad and most of northern South America.

SIGMATOSTALIX AMAZONICA Schltr. Beih. Bot. Centralbl. **42**^{2}: 148. 1925. Plant small, slender, variable, rarely up to 25 cm. high; pseudobulbs clustered, oblong-ellipsoid, complanate, 1-leaved at the apex, up to 2.8 (rarely 3.5) cm. high, surrounded on each side by two or three imbricating sheaths of which the upper pair bears a small leaf; leaves linear to elliptic-oblong, acute, gradually narrowed below to a more or less distinct petiole, up to 14.5 cm. long; scapes lateral, basal, in the axil of the inner sheath, slender, erect to ascending, several- to many-flowered, rarely up to 18 cm. long, forming a narrow wand-like panicle with commonly very short loosely few-flowered branches; flowers very small, membranaceous; sepals and petals narrow, oblong, similar, greenish-white, olive or yellowish, barred with pink or brown; lip larger than the other segments, yellow, simple, cuneate-obovate or flabellate, rounded in front; column very slender. SURINAM: rare epiphyte in damp high bush, base of north escarpment, Tafelberg, *24330*. Brazil and Peru.

LOCKHARTIA sp. aff. *L. micrantha* Reichb. f. (sterile). Plant medium-sized, caespitose; stems numerous, spreading, up to 30.5 cm. long, entirely concealed by very numerous, distichously imbricating leaves; leaves equitant, small, obliquely triangular (when viewed from the side), obtuse or subtruncate at the apex, about 1.8 cm. or less long on the outer margin; no flowers present. BRITISH GUIANA: epiphytic in *Manicaria* swamp, flowers solitary, axillary, stalked, subtended by pale green amplexicaul bracts, 3 outer petals pale greenish-yellow, reflexed, 2 inner ones the same color, spreading lip yellow, finely marked with brown, stigma hooded, pale green, Kaituma River, Sebai Creek, *F2420*.

DICHAEA sp. Plant small, caespitose; stems spreading, 11 cm. or less high, entirely concealed by imbricating leaf-sheaths; leaves very numerous, loosely distichous, linear-oblong, acute, mucronate, complicate below, sessile at the articulated base, up to 3.3 cm. long, spreading-ascending; inflorescences very short, axillary, 1-flowered; floral fragments on summit of ellipsoid densely echinate ovary. BRITISH GUIANA: rare epiphyte, Kaieteur Plateau, *23343*.

DICHAEA sp. (sterile) aff. *D. muricata* (Sw.) Lindl. Plant small, simple; stem suberect, up to 17.5 cm. long, entirely concealed by the abruptly sheathing bases of the leaves; leaves very numerous, densely or subdensely distichous, small, horizontally spreading, oblong, abruptly acute and mucronate, about 1.9 cm. or less long, unjointed, with semiamplexicaul imbricating bases, the anterior margins being ciliolate; no flowers present. BRITISH GUIANA: rare, on moist rock surfaces in high mixed forest, Potaro River Gorge, *23531*.

DICHAEA sp. Plant small, caespitose, possibly conspecific with *23343;* stems spreading, up to 13 cm. long, entirely concealed by the imbricating leaf-sheaths; leaves very numerous, loosely distichous, linear or oblong-linear, acute, mucronate, complicate below, sessile at the articulated base, up to 3.3 cm. long, spreading-ascending; old fruit ellipsoid, densely echinate. SURINAM: frequent epiphyte, high forest, base of south escarpment, Arrowhead Basin, Tafelberg, *24522*.

DICHAEA RENDLEI Gleason. Bull. Torrey Club **54**: 604. 1927. Plant small, slender, caespitose, stems slender, spreading, straight or lightly flexuous, up to about 17 cm. long, entirely concealed by imbricating leaf-sheaths; leaves slender, numerous, distichous, articulated, ascending-spreading, linear or linear-oblong, abruptly acute, mucronate, about 2.5 cm. or less long; inflorescences rather numerous, abbreviated, axillary, 1-flowered; flower very small, white, membranaceous; sepals ovate to oblong-lanceolate, the lateral sepals oblique; petals ovate or ovate-lanceolate; lip anchor-shaped, apiculate at the broadly rounded apex, produced near the middle on each side into a recurved obliquely linear-oblong lobule, long-cuneate toward the base. BRITISH GUIANA: occasional epiphyte on *Eperua*, wallaba forest, on Bartica-Potaro Road, *23557;* between Demerara and Berbice Rivers, *De la Cruz 1623* (type). Perhaps also Trinidad and Guadeloupe.

CAMPYLOCENTRUM MICRANTHUM (Lindl.) Rolfe, Orch. Rev. **11**: 245. 1903. *Angraecum micranthum* Lindl. Bot. Reg. **21**: *pl. 1772*. 1836. Plant medium-sized or rather large; stems very variable in length, simple, rather stout, up to 42 cm. or more long, entirely concealed by close tubular leaf-sheaths, freely rooting below or throughout; leaves numerous, loosely distichous, narrowly oblong, elliptic-oblong or broadly elliptic, commonly obliquely bi-

lobed at the obtuse apex, sessile at the cuneate or subrounded base, up to 8.6 (rarely 12.5) cm. long; inflorescences lateral, 1 or 2 together, commonly nearly opposite the leaves, more or less shorter than the leaves, densely many-flowered to the base, commonly secund-flowered; flowers very small, white; sepals and petals narrow, acute or short-acuminate, parallel below with often recurved apices; lip with a prominent curved clavate spur; lamina lanceolate in outline, distinctly 3-lobed below the middle, with the lateral lobes short and dentiform and the mid-lobe much longer, triangular-lanceolate and porrect. BRITISH GUIANA: rare epiphyte in mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22922*. Mexico through Central America to Panama, the West Indies and most of northern South America.

BULLETIN OF THE TORREY BOTANICAL CLUB
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TORREYA

PROCEEDINGS OF THE CLUB

Minutes of the Meeting of October 7, 1947. The meeting was called to order at the Brooklyn Botanic Garden at 8: 30 p.m. by the President, Dr. Shull. Thirty members and friends were present.

Dr. Shull announced that the speaker at the October 15th meeting at Hunter College would be Dr. Naylor of the New York Botanical Garden.

Many of the members present then told of their summer experiences which included observations in the local field and the more distant fields of Canada, the Gaspé, and Greenland.

The meeting was adjourned at 9: 55 p.m. and was followed by refreshments served by Dr. and Mrs. Graves.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of October 15th, 1947. The meeting was called to order by President Shull at 8: 30 p.m. at Hunter College. Fifty-two members and friends were present. The minutes of the preceding meeting were accepted as read. Dr. Shull announced that there would be no meeting on Election Day, November 5th, and that the meeting of November 19th would be held at the New York Botanical Garden.

Dr. Naylor of the New York Botanical Garden staff then spoke of the interesting work involved in planning and producing motion picture films at the Garden. Two films, the first depicting scenes and activities at the Garden and the sound film, ''The Gift of Green,'' were then shown to the meeting.

The meeting adjourned at 9: 55 p.m. and refreshments were served by the Botany department of Hunter College.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of December 17, 1947. The meeting was called to order at the New York Botanical Garden at 3:30 p.m. by President Shull. Twenty-three members and friends were present. The minutes of the preceding meeting were approved as read. Dr. Shull then introduced the speaker, Dr. Conrad B. Link, of the Brooklyn Botanic Garden staff. Dr. Link spoke on the topic of ''Botanical Research Applied to Commercial Horticulture.'' The abstract of his talk follows:

> Many of the results of recent botanical investigation have led to their application in the field of commercial horticulture. Research in the field of photoperiodism and the influence of light on plants has resulted in the commercial use of additional light in the growing of certain greenhouse flowers especially annuals, during the winter. A long day may be produced with ordinary mazda lamps, resulting in a more rapid growth and earlier flowering. Short day treatment of fall-blooming chrysanthemums is a regular part of the florist's program to produce better flowers earlier in the season than normal. Just now there is considerable interest in prolonging their period of bloom so that they may be available as cut flowers during the spring months, by artificially manipulating the day length.
>
> The great interest in soilless culture has found practical application under greenhouse conditions, especially for rose growing, and to a lesser extent for carnations and tomatoes. The ''gravel'' method has been found most practical for greenhouse conditions.
>
> In the field of hormones and related chemicals, so many new developments

have been found for this group of materials that the many commercial possibilities are barely started. The first widespread commercial use of these was in the field of plant propagation where indole butyric acid and napthalene acetic acid have now become standard products. Other applications have been found for the use of hormones in producing seedless fruits, and insuring a set of fruit on tomatoes; preventing or delay in the pre-harvest drop of apples, and aiding in the ripening of such fruits as bananas and apples. The use of 2, 4-Dichlorophenoxyacetic acid as a selective weed killer is widespread for lawns, fields, pastures, along roadsides and in vacant areas. Much research is continuing with this and other materials for weed control. Many other discoveries in the control of plant growth with chemicals are now beginning to find some use, such as breaking or delaying the dormancy especially in potatoes; and controlling the flowering of pineapple.

In the field of plant breeding the use of chemicals to induce polpoidy is now a part of the breeder's equipment, while the use of embryo culture is of considerable value with many plants. Many other phases of botanical research provide direct or additional information which find commercial application. To mention only a few would include diseases and their control, genetical studies of horticultural plants, plant nutrition and ecological studies.

After the discussion period, the meeting was adjourned at 4:30 p.m. Tea was then served by the Garden staff.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of December 2, 1947. The meeting was called to order at 8:05 p.m. at Columbia University by President Shull. Approximately 90 members and friends were present. The minutes of the preceding meeting were approved as read.

Fourteen persons were elected to Active Membership, and two to Associate Membership. One resignation from Associate Membership was accepted with regret.

Dr. Shull then introduced Dr. Paul Burkholder of Yale University who spoke on the topic of "Studies of Growth Factors of Microorganisms."

After a discussion and question period, the meeting was adjourned at 9:35 p.m. Tea was served by the Botany Department of Columbia University.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Minutes of the Meeting of November 19th, 1947. The meeting was called to order at 5:30 p.m. by President Shull at the New York Botanical Garden. Twenty-five members and friends were present. The minutes of the preceding meeting were approved as read.

Ten persons were unanimously elected to Active Membership, and seven to Associate Membership. Prof. Nicholas Polunin of Montreal was elected a Life Member.

Dr. Shull then introduced the speaker, Dr. Edwin B. Matzke, whose subject was the "Three-Dimensional Shapes of Epidermal Cells." Lantern slides and models of the various cell shapes were used to illustrate the talk. The speaker's abstract follows:

Upper epidermal cells of the leaf base of *Aloe aristata* were studied in position, and number and kinds of faces were recorded. This epidermis was selected because its cells were relatively regular and uniform and underlain by cells of approximately the same volume as those of the epidermis. The average number of faces for 200 cells was 10.885, the range being from 8 to 16. The faces varied from triangular to octagonal; 48.6 per cent were pentagonal.

Epidermal cells of the meristematic stem apex of *Elodea*, above the place of origin of the leaf primordia, were similarly studied in total mounts. The average number of faces for 200 cells was 10.005, with a range from 7–14. Pentagonal and quadrilateral faces were most common. The deviation from 11 in

Elodea is explained by the presence of subepidermal cells greater in volume than the epidermal. The meristematic epidermal cells of *Elodea* were not markedly different in shape from those of the more mature leaf epidermis of *Aloe*. In both instances the similarity to peripheral bubbles in a foam was greater than to peripheral compressed shot, emphasizing the significance of surface forces in three-dimensional cell shape determination.

After a discussion of the talk, the meeting was adjourned at 4:45 p.m.

Respectfully submitted,
HONOR HOLLINGHURST,
Acting Recording Secretary

Report of the Field Committee. A program of fifty-four field trips was arranged for the week-ends between March 23, and November 9, 1947. Nearly fifty members and friends of the Club contributed their ability and time to lead these trips. Some of the trips were joint affairs with other organizations having similar interests; at other times we were the guests of other groups. The printed schedule makes due acknowledgements.

When available, reports of the trips have been published under Proceedings, in the Torreya Section of the Bulletin. Trips ranged from objectives reached by the New York City subways to places in Connecticut, New Jersey, Pennsylvania, Kentucky, and the Province of Quebec. This was the second trip around Gaspé for the Torrey Club.

The Local Flora Committee. In the spring of 1947 the Council put the Local Flora Committee under the same chairmanship as the Field Committee. This has resulted in no material changes in the activity of either committee to date, but certain things may perhaps be more properly reported as Local Flora Committee activities. Our By-Laws instruct the Local Flora Committee "to prepare complete and accurate lists of all the plants, native, naturalized, and adventive, occurring within one hundred miles of New York City. . . ." These lists as currently available are somewhat out of date. The leaders of some field trips have compiled check lists of a few localities. Additions have been made to these during 1947, notably the list from Cheesequake State Park and from the Forked River area.

Two of our members, Mrs. F. C. Dunham and Mr. G. G. Nearing, were asked to make a survey of the proposed Greenbrook Sanctuary in the New Jersey section of Palisades Interstate Park. Three trips were scheduled through the season for this purpose and a comprehensive list has been compiled.

In response to requests made on field trips for an explanation of plant names, one of our members, Mr. Hollis Koster, has prepared a list of about two hundred-fifty scientific names with their derivations. This will be mimeographed for distribution to those interested.

Mention was made, in reporting the appropriate trip (Forked River, June 21–22), of the discovery of a small colony of *Listera australis* Lindl. Another unusual species from the same locality is *Epilobium rosmarinifolium* Pursh, a segregate from *E. densum* Raf. Ours is said to be the only known coastal plain station. The extension of the range of *Myrica cerifera* L., the story of the rediscovery of *Fossombronia cristula* Aust., and the successful search for *Telaranea nematoides* (Aust.) Howe in the pine barrens were described in reporting the Mullica River Valley trip of August 30–September 1.

In view of its own responsibility, the Local Flora Committee is anxious to record any lists of plants from our range that may be published by others. During 1947 two of our members, M. A. Chrysler and J. L. Edwards, issued the *Ferns of New Jersey* (eighty-one species with descriptions, photographs, and maps of distribution—Rutgers University Press, $4.00). Another member, G. G. Nearing issued *The Lichen Book*, 648 pages; a great many species in which are described from material collected locally (published by the author, Box 338, Ridgewood, New Jersey).

JOHN A. SMALL,
Chairman

Field Trip Reports

June 28–29. Hunter Lake, New York. This lake in the Catskills at 2200 feet elevation is in a richly forested area. Nearby Mud Pond affords a northern bog habitat, with large expanse of shrubby plants, *Chamaedaphne*, sheep laurel, etc., with spruce and larch invading. Plants mentioned in the report included *Sorbus americana*, *Ilex monticola*, *Luzula saltuensis*, *Waldsteinea fragarioides* (an exceptionally large patch of this), *Menyanthes trifoliata*, *Vaccinium Oxycoccus*, *Viburnum alnifolium*, *Sambucus racemosa*, *Acer spicatum*, *Streptopus roseus*, *S. amplexifolius*, etc. Pteridophytes included some less common species as *Asplenium angustifolium*, *Onoclea struthiopteris*, *Aspidium goldianum*, *Phegopteris polypodioides*, *Botrychium lanceolatum* var. *angustisegmentum*, *B. ramosum* (= *B. matricariaefolium* of recent authors).

Attendance 19. Leader, J. A. Crabtree.

August 17. Cheesequake State Park, New Jersey. A joint trip with the Academy of Natural Sciences of Philadelphia. The walk included Arrowsmith Point, Barton Spring, and the white cedar swamp near the museum. *Strophostyles umbellata* (Muhl.) Britton was found. The northern coastal limit of this plant is Long Island. *Sagittaria latifolia* Willd. is a common arrowhead of the central Jersey Region. *Apocynum cannabinum* L., *Crotalaria sagittalis* L., *Plantago aristata* Michx., *Ipomoea hederacea* Jacq., *Lycopus americanus* Muhl., *Desmodium rotundifolium* (Michx.) DC., *Rhus glabra* L., *Lespedeza procumbens* Michx., *Typha latifolia* L., *Lechea Leggettii* Britton & Hollick, and *Collinsonia canadensis* L., were also added to our list from the Park.

Attendance 25. Leader, L. E. Hand.

August 30–September 1. Mullica River Valley, N. J. The group visited a station for *Myrica cerifera* L. discovered in the spring of 1947 by L. E. Hand at Lower Bank. The plants were in good fruit. This is thought to be the northernmost station known for this species. The group then visited Green Bank, Weekstown, Bulltown, Batsto, and Pleasant Mills. Among species seen were *Isoetes Brauni*, *Schizaea pusilla*, *Prenanthes autumnalis* (*P. virgatum*), *Rhyncospora microcephala*, *Scleria nitida*, *Eupatorium resinosum*, *Breweria pickeringii*, *Crotonopsis elliptica* (*C. linearis*), *Gentiana porphyrio*, *Lobelia canbyi*, *Sphagnum macrophyllum*, *Fossombronia cristula*, and *Telaranea nematodes*.

"As Mr. Beals and Mr. Nearing were along, we concentrated no little on hepatics and collected about 20 species of these. Here came the fun. As *Fossombronia cristula* was first collected at Batsto by Austin, we searched particularly for this. We found *Fossombronia* several times but too early for fruit desired for determination as to species. This has now been done and rediscovery of this species in the pine barrens is now established.

"I think I shall tell a bit about the *Telaranea*; it seems very interesting. It is the best example I know of what is called an 'Atlantic species' of moss. Its occurrence rings the coastal regions of this ocean from deep in Africa to deep in South America. Collections through the years have been few and widely spaced geographically. It did not turn up in the United States until relatively late years. In 1910 Miss Haynes cited several stations in coastal United States (the first report made upon its occurrence in this country). Mr. Beals has turned it up twice from high points in the Catskills. He found traces in three specimens taken on this trip (the normal way it is found). He expressed curiosity as to whether it was ever collected except as straggling strands amongst other hepatics. I suspect it has been collected more or less pure in at least one tropical collection as a note was made on its facies.

"To find it so readily in the pine-barrens (the first it has been collected here, we can well suppose) was an unavoidable challenge to search out some material pure enough to call a 'real specimen' of *Telaranea*.

"It was one of those unencouraging searches—it hid totally for a while. Then I spotted weak traces and spent several hours scraping up bits of muddy material. I attempted washing, and dried specimens were merely small disappointing-looking plates of dried mud. Hoping to process better specimens, I returned and re-collected. Began to get dark so walked up the ditch toward the highway. On way with my handful of

scrapings, the eye caught a plate of peculiar-looking material on the bank of the ditch. It was about six square inches of massed cushions of pure *Telaranea!* A hasty search seemed to suggest that I could expect no more. I suspected that this colony had taken some unique notion to proliferate freely.

"Of course it is a romantic species (to hepatologists) and perhaps has a privilege to behave so elusively. The next search (of course with better clues as to where it may be found—it is not actually difficult to spot when one faces it) more was found, and more abundantly at another site. The pine-barrens had finally come through grandly."

Attendance 9. Leader, Hollis Koster.

September 14. Cheesequake State Park, New Jersey. The area along Cheesequake Creek near the old steamboat dock was visited first for the mud flat habitat. The old field near the museum yielded some new weed species. Salt marsh was traversed near the spring and then the group explored Bluebell Island. Asters, goldenrod, and other composites were plentiful as were fall maturing grasses. Eight or ten new species were added to our lists.

Many additions have been made to all of our lists and revised copies will be made available to any who request them.

Attendance 14. Leader, John A. Small.

September 21. Franklin Lake, New Jersey. Some members of the Yosian Alpinist group and of Newark Nature Club were our guests. Attention was primarily devoted to the evergreens, native and introduced, though the ground plants were not without interest. This walk is pleasant just for the sort of country it traverses.

Attendance 10. Leader, Dr. H. B. Gordon.

October 4–5. Island Beach and pine barrens of New Jersey. A joint trip with the Connecticut Botanical Club. Zonation around ponds of varying salinity at Point Pleasant was followed by observation of the coast strip type of forest as we followed up the Metedeconk River. Typical pine barrens were seen in the vicinity of Lakewood Airport. The group then went to Forked River for a good pine barrens bog with the usual fall aspect.

On Sunday we visited Island Beach for plants of the dunes, thickets, forests, and littoral aspects displayed so nicely there. The *Hudsonia* heath attracted much comment. Holly berries were attractive and other species showed the features to be expected in autumn.

Attendance 16. Leader, John A. Small.

October 11. West Park, New York. The Torrey Club had made no autumn pilgrimage to Slabsides, the rustic retreat where John Burroughs did much writing, in many years. This joint trip with members of the John Burroughs Association was enjoyable from the autumnal aspect of the vegetation and surroundings. The day was ideal. Perhaps there were more highlights among the company than among the plants observed. The report notes, "Edwin W. Teale, Dr. Clyde Fisher, Professor Inez Haring, Princess Teata, and Julian Burroughs. Julian and Dr. Fisher read parts of John Burrough's essays relating to Slabsides."

Attendance 24. Leader, N. H. Moldenke.

October 12. Princeton, New Jersey. The group put to sea on Lake Carnegie, portaged the canoes to Millstone River, and paddled up to a point affording an easy walk to Walker-Gordon Pond. Aquatic species included spatterdock, pickerel-weed, bur-reed, *Sagittaria.* Alders along the shorelines attracted attention. The 1948 staminate catkins were already visible; female units for 1946, 1947, and 1948 were found. Autumn coloring was noted in *Cornus,* sweet gum, sour gum and ash. Conspicuous fruits were evident on winterberry, spicebush, and hawthorn. Birds included three great blue heron (one very tame), five species of *Charadrii,* six or seven species of Anatidae.

Attendance 7. Leader, C. H. Rogers.

October 19. Schunemunk Mountain, New York. This hike started from the Mountain Lodge colony, climbing up through the oak-hickory forest on an unmarked trail.

Lichens and fungi were perhaps best represented at the season though other species of plants and animals, including a wood frog, were not overlooked. The summit trail was followed nearly to the high point. A blue blazed trail was then followed left leading a steep and rocky descent onto a bottomland, still well up on the mountain, where a swampy area rewarded the hepaticologists in the group. A short walk led to the cabin colony but a thunderstorm accelerated our progress considerably. Food and, where necessary, dryness were provided at the leaders' pleasant lodge.

Attendance 10. Leader, Alexander V. Tolstoouhov.

October 26. Budd Lake, Morris County, New Jersey. The ecologist is always concerned with physiography and our first assignment was to climb a fire tower and see how the terminal moraine across New Jersey had brought Budd Lake into existence. Vegetation tends to exterminate lakes. Bud Lake is not in danger of disappearance but it is smaller than that created by the glacier. There was an island then. The island has been connected with the main land by an encroaching bog and swamp growth. Northern plants such as spruce and larch were seen. A floating mat was reached at the water's edge and some members took a swim from this. The water was found to be cold, deep, muddy, but exhilarating. It was determined that if the mat is extending at the point visited its progress is exceedingly slow. A red maple four or five inches in diameter was within a few inches of the water's edge. It was decided that ice and the action of storm waves hold the invading plants in check.

Attendance 31. Leader, Murray Buell.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

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FUNGI AND LICHENS

Carvajal, Fernando. The production of spores in submerged cultures by some *Streptomyces.* Mycologia **39:** 426–440. *f. 1–7.* Jl [Au] 1947.

Drechsler, Charles. Three new species of *Zoöpage* predaceous on terricolous rhizopods. Mycologia **39:** 379–408. *f. 1–7.* Jl [Au] 1947.

Gilkey, Helen M. New or otherwise noteworthy species of Tuberales. Mycologia **39:** 441–452. *f. 1–17.* Jl [Au] 1947.

Hahn, Glenn Gardner. Analysis of Peck's type of *Meliola balsamicola* and *Asterina nuda.* Mycologia **39:** 479–490. *f. 1, 2.* Jl [Au] 1947.

Martin, G. W. Taxonomic notes on Myxomycetes. II. Mycologia **39:** 453–462. Jl [Au] 1947.

Mix, A. J. Some new species of *Taphrina.* Trans Kan. Acad. **50**[2]: 77–83. *1 f.* 1947.

Nickerson, Walter J. *Editor.* Biology of pathogenic fungi. Ann. Cryptog. Phytopath. **6:** *i–xx,* 1–236. *illustr.* 1947.

Olive, Lindsay S. Cytology of the teliospores, basidia, and basidiospores of *Sphenospora kevorkianii* Linder. Mycologia **39:** 409–425. *f. 1–4.* Jl [Au] 1947.

Wehmeyer, Lewis E. Studies on some fungi from northwestern Wyoming. Mycologia **39:** 463–478. *f. 1, 2.* Jl [Au] 1947.

PTERIDOPHYTES

(See also under Spermatophytes: **Horr & McGregor**)

Reed, Clyde F. Fern and fern-allies of the Gunpowder River region, Baltimore County, Maryland. Castanea **12:** 76–88. S [N] 1947.

Shaver, Jesse M. The southern lady fern, the New York fern, and the marshfern. (Concl.) Jour. Tenn. Acad. **22:** 255, 256. *f. 121.* O [N] 1947.

Shaver, Jesse M. Study of the Tennessee ferns belonging to the genus *Dryopteris* (pars.). Jour. Tenn. Acad. **22:** 257–302. *f. 122–143.* O [N] 1947.

SPERMATOPHYTES

(See also under Genetics: **Hutchinson, Silow & Stephens; Nielsen;** under General Botany: **Mayr**)

Agrelius, Frank V. G. Botanical notes: 1946. Trans. Kan. Acad. **50**[2]: 172, 173. 1947.

Ames, Oakes. Commentaries on *Spiranthes,* I. Bot. Mus. Leafl. **13:** 17–31. *pl. 1–3.* 19 N 1947.

Artz, Lena. A white-flowered *Desmodium* from Virginia. Rhodora **49:** 299, 300. D 1947.

Baker, Milo S. A new violet [*Viola galeanaensis*] from Mexico. Madroño **9:** 131–133. O [D] 1947.

Cory, V. L. Two varieties of *Condalia* from Texas. Madroño 9: 128–131. O [D] 1947.

Daniel, H. Apuntes sobre algunas gramineas colombianas. Bol. Inst. Bot. Univ. Cent. [Quito] 5⁶⁻⁷: 171–182. Je 1947.

Davis, H. A. & Ball, Carleton R. The willows of West Virginia. Castanea 12: 94–100. S [N] 1947.

Degener, Otto [& Greenwell, Amy]. Flora Hawaiiensis. 13 lamina [incl. f. nov. in *Scaevola mollis*]. 1 O 1947.

Dugand, Armando. Noticias botanicas colombianas, IX. Caldasia 4: 427–430. 1 S 1947.

Dugand, Armando. Observaciones taxonómicas sobre las *Lecythis* del norte de Colombia. Caldasia 4: 411–426. *f. 1–13.* 1 S 1947.

Epling, C. Natural hybridization of *Salvia apiana* and *S. mellifera.* Evolution 1: 69–78. *f. 1–4.* Mr [Jl] 1947.

Epling, Carl. Supplementary notes on American Labiatae—IV. Bull. Torrey Club 74: 512–518. 29 N 1947.

Ewan, Joseph. A revision of *Chorisepalum,* an endemic genus of Venezuelan Gentianaceae. Jour. Wash. Acad. 37: 392–396. *f. 1.* 15 N 1947.

Fanshawe, D. B. Studies of the trees of British Guiana, II. Greenheart (*Ocotea Rodiaei* [Schomb.] Mez.). Trop. Woods 92: 25–40. 1 D 1947.

Fassett, N. C. *Penstemon gracilis,* var. *wisconsinensis.* Rhodora 49: 298. D 1947.

Fernald, M. L. *Crepis nana* not yet known from Gaspé. Rhodora 49: 299. D 1947.

Fernald, M. L. The varieties of *Solidago uliginosa.* Rhodora 49: 294–297. D 1947.

Gier, L. J. & Ponder, Wanda. Flowering plants of Clay County, Missouri. Trans. Kan. Acad. 50²: 194–199. 1947.

Gould, Frank W. Nomenclatorial changes in *Elymus* with a key to the Californian species. Madroño 9: 120–128. O [D] 1947.

Harper, Roland M. Preliminary list of Southern Appalachian endemics. Castanea 12: 100–112. S [N] 1947.

Heiser, Charles B. Hybridization between the sunflower species *Helianthus annuus* and *H. petiolaris.* Evolution 1: 249–262. *f. 1–5.* D 1947.

Horr, W. H. A rapid plant dryer. Trans. Kan. Acad. 50²: 191–193. *1 f.* 1947.

Horr, W. H. & McGregor, R. L. Kansas plants new to Kansas herbaria II. Trans. Kan. Acad. 50²: 200, 201. 1947.

Isely, Duane. Investigations of seed classification by family characteristics. Iowa Exp. Sta. Res. Bull. 351: 317–380. *pl. 1–10.* Jl 1947.

Lawrence, George Hill Mathewson. Keys to cultivated plants, families and herbaceous genera. 1–78. Ithaca, N. Y. 1946.

Little, Elbert L. Does mahogany (*Swietenia*) occur in Ecuador? Trop. Woods 92: 41–43. 1 D 1947.

Little, Elbert L. The name of the wild dilly of Florida [*Achras emarginata*]. Rhodora 49: 289–293. D 1947.

Moldenke, H. N. Additional notes on the genus *Aegiphila.* VIII. Phytologia 2: 387–400. N [D] 1947.

Moldenke, H. N. The known geographic distribution of the members of the Eriocaulaceae. Supplement 2. Phytologia 2: 372–381. N [D] 1947.

Moldenke, H. N. The known geographic distribution of the Verbenaceae, Avicenniaceae, Stilbaceae, and Symphoremaceae. Supplement 7. Phytologia 2: 382–387. N [D] 1947.

Moldenke, Harold Norman. A list of the locations of the principal collections of Verbenaceae, Avicenniaceae, Stilbaceae, Symphormaceae, and Eriocaulaceae. Supplement 1. 1–27. 15 N 1947 [Offset—privately printed].

Moldenke, H. N. Notes on new or noteworthy plants. III. Phytologia **2:** 363–372. N [D] 1947.

Ownbey, Gerald B. Monograph of the North American species of *Corydalis.* Ann. Mo. Bot. Gard. **34:** 187–260. *pl. 28–31. maps. 1–13.* 31 O 1947.

Pittier, H., *et al.* Catálogo de la Flora Venezolana. II [Geraniaceae to Compositae, incl.] 1–577. Comite Organizador, Tercera Conferencia Interamericana de Agricultura. 4 S 1947.

Pohl, Richard. *Panicum commonsianum* and its midland representative. Am. Midl. Nat. **38:** 506–509. *f. 1 + table 1.* S [N] 1947.

Porter, C. L. A new species of *Oxytropis* [*obnapiformis*] from the Central Rocky Mountains. Madroño **9:** 133–135. *f. 1–3.* O [D] 1947.

Seibert, R. J. A study of *Hevea* (with its economic aspects) in the Republic of Peru. Ann. Mo. Bot. Gard. **34:** 261–352. *pl. 32–44 + f. 1–6.* 31 O 1947.

Smith, A. C. The families Illiciaceae and Schisandraceae. Sargentia **7:** 1–224. *f. 1–41.* 28 N 1947.

Sodiro, P. Luis. Ojeada sobre la vegetación del Ecuador. Bol. Inst. Bot. Univ. Cent. [Quito] 5^{6-7}: 192–247. Je 1947.

Stehlé, Henri. Notes taxonomiques, xylologiques et géographiques sur les chataigniers du genre *Sloanae* des Petites Antilles. Carib. Forest. **8:** 301–322. O 1947.

Swallen, Jason R. The awnless annual species of *Muhlenbergia.* Contr. U. S. Nat. Herb. **29:** 203–208. 1947.

Uitewaal, A. J. A. A first attempt to subdivide the genus *Haworthia,* based on floral characters. Des. Pl. Life **19:** 133–136. *2 f.* N 1947.

Uribe-Uribe, Lorenzo. Leguminosas nuevas de Colombia. Caldasia **4:** 405–409. 1 S 1947.

Van Melle, P. J. From texts to plants—or from plants to texts? Phytologia **2:** 353–363. N [D] 1947.

PALEOBOTANY

(See also under Morphology: **Calder**)

Andrews, Henry N. Ancient plants and the world they lived in. *i–ix,* 1–279. *f. 1–166.* Comstock Publ. Co., Ithaca, N. Y. 1947.

Arnold, Chester A. An introduction to paleobotany. *i–ix,* 1–433. *front. + f. 1–187.* McGraw-Hill Co., New York & London. 1947.

Cross, A. T. Spore floras of the Pennsylvanian of West Virginia and Kentucky. Jour. Geol. **55:** 285–308. My 1947.

Kosanke, R. M. Plant microfossils in correlation of coal beds. Jour. Geol. **55:** 280–284. My 1947.

Read, C. B. Pennsylvanian floral zones and floral provinces. Jour. Geol. **55:** 271–279. My 1947.

ECOLOGY AND PLANT GEOGRAPHY

(See also under Plant Physiology: **McCool;** under General Botany: **Mayr**)

Allard, H. A. Light intensity studies in Canaan Valley, West Virginia. Castanea **12:** 63–74. S [N] 1947.

Bignoli, Dario. Contribución al estudio de praderas naturales en el departamento de Yolo, California. Revista Argent. Agron. **14:** 240–246. *tables 1, 2.* 5 S 1947.

Brewer, Howard E. Response of certain legumes to variations in soil and micro-climate on eroded areas in southeastern Iowa. Ecol. Monogr. **17**: 471–500. *f. 1–21 + tables 1–17.* O [N] 1947.

Daubenmire, R. F. & Deters, M. E. Comparative studies of growth in deciduous and evergreen trees. Bot. Gaz. **109**: 1–12. *f. 1–10.* S [O] 1947.

Davidson, John F. The polygonal graph for simultaneous portrayal of several variables in population analysis. Madroño **9**: 105–110. *f. 1–6.* O [D] 1947.

Egler, Frank E. Arid southeastern Oahu vegetation, Hawaii. Ecol. Monogr. **17**: 383–435. *f. 1–41.* O [N] 1947.

Gall, Harold J. F. Flowering of smooth brome grass under certain environmental conditions. Bot. Gaz. **109**: 59–71. *f. 1–6.* S [O] 1947.

Jacobs, Don L. An ecological life-history of *Spirodela polyrhiza* (greater duck-weed) with emphasis on the turion phase. Ecol. Monogr. **17**: 437–469. O [N] 1947.

Potter, Loren D. Post-glacial forest sequence of north-central Ohio. Ecology **28**: 396–417. *illust.* O [D] 1947.

Rigg, George B. Soil and air temperatures in a sphagum bog of the Pacific coast of North America. Am. Jour. Bot. **34**: 462–469. *f. 1–7 + tables, 1, 2.* N [D] 1947.

Tisdale, E. D. The grasslands of the southern interior of British Columbia. Ecology **28**: 346–382. *f. 1–12 + tables 1–22.* O [D] 1947.

PHYTOPATHOLOGY

(See also under Plant Physiology: **Beale & Lojkin; Yardwood;** under Morphology: **Blodgett & Nielsen**)

Berkeley, G. H. A strain of the alfalfa mosaic virus on pepper in Ontario. Phytopathology **37**: 781–787. *f. 1, 2.* N 1947.

Cochran, G. W. A chromatographic method for the detection of tobacco-mosaic virus in juice from diseased Turkish tobacco plants. Phytopathology **37**: 850, 851. *f. 1.* N 1947.

El-Helaly, A. F. The black-point disease of wheat. Phytopathology **37**: 773–780. *tables 1–4.* N 1947.

Good, H. M. Studies on the *Cladosporium* blight of sweet pea. Canad. Jour. Res. C. **25**: 137–154. *f. 1–11.* O 1947.

Holton, C. S. Host selectivity as a factor in the establishment of physiologic races of *Tilletia caries* and *T. foetida* produced by hybridization. Phytopathology **37**: 817–821. N 1947.

Johnson, James. Virus attenuation and the separation of strains by specific hosts. Phytopathology **37**: 822–837. *f. 1–5* N 1947.

LeBeau, F. J. & Reynolds, F. J. Treatment of lily bulbs for black scale control. Phytopathology **37**: 801–808. *tables 1–5.* N 1947.

Litzenberger, S. C. & Murphy, H. C. Methods for determining resistance of oats to *Helminthosporium victoriae.* Phytopathology **37**: 790–800. *f. 1–4.* N 1947.

Rader, Wm. E. *et al.* A seed-born virus of muskmelon. Phytopathology **37**: 809–816. *f. 1, 2 + tables 1, 2.* N 1947.

Riley, C. G. Heart rot of oaks caused by *Polyporus obtusum.* Canad. Jour. Res. C. **25**: 181–184. *f. 1–7.* O 1947.

Slagg, C. M. & Fellows, Hurley. Effects of certain soil fungi and their by-products on *Ophiobolus graminis.* Jour. Agr. Res. **75**: 279–293. *f. 1, 2 + tables 1–4.* D. 1947.

Slykhuis, John T. Studies on *Fusarium culmorum* blight of crested wheat and brome grass seedlings. Canad. Jour. Res. C. **25**: 155–180. *f. 1–8.* O 1947.

Valleau, W. D. & Johnson, E. M. The relation of meadow nematodes to brown root-rot of tobacco. Phytopathology **37**: 838–841. N 1947.

Yarwood, C. E. The fungicidal value of mixtures of lime sulphur and zinc sulphate. Phytopathology **37**: 852, 853. *f. 1.* N 1947.

MORPHOLOGY

(including anatomy & cytology in part)

Allard, H. A. The direction of twist of the corolla in the bud, and twining of the stems on Convolulaceae and Dioscoreaceae. Castanea **12**: 88–94. S [N] 1947.

Beal, J. M. Some results of cross-pollination on *Lilium regale.* Bot. Gaz. **108**: 526–530. *f. 1–14.* Je [9 Jl] 1947.

Blodgett, Earle C. & Nielsen, L. W. Fasciation in russet Burbank potatoes. Phytopathology **37**: 597–600. *f. 1, 2.* Au 1947.

Boatner, Charlotte H. *et al.* Pigment glands of cotton seed. II. Nature and properties of gland walls. Bot. Gaz. **108**: 484–494. *f. 1–4.* Je [9 Jl] 1947.

Brink, R A. & Cooper, D. C. The endosperm in seed development. Bot. Rev. **13**: 423–477. O 1947; 479–541. N.

Calder, Mary G. Pseudangiospermy and pollination. Proc. Linn. Soc. **159**: 18–20. 1947.

Covas, Guillermo & Schnack, Benno. Estudio cariológicos en Antófitas. II Parte. Revista Argent. Agron. **14**: 224–231. *f. 1–44 + table 1.* 5 S 1947.

Cozzo, Domingo. Nuevas casos de raices gemiferas en plantas leñosas argentinas. Revista Argent. Agron. **14**: 247–254. 5 S 1947.

Eames, Arthur Johnson & MacDaniels, Laurence H. An introduction to plant anatomy. 2nd ed. *i–xvii,* 1–427. *illust.* McGraw Hill. New York, 1947.

Foster, Adriance S. Structure and ontogeny of the terminal sclereids in the leaf of *Mouriria huberi* Cogn. Am. Jour. Bot. **34**: 501–504. *f. 1–32.* N [D] 1947.

Goodspeed, T. H. Maturation of the gametes and fertilization in *Nicotiana.* Madroño **9**: 110–120. *pl. 18, 19.* O [D] 1947.

Kausik, S. B. & Subramanyam, K. Embryology of *Cephalostigma schimperi.* Bot. Gaz. **109**: 85–90. *f. 1–41.* S [O] 1947.

Little, Ruby R. Histology of barks of *Cinchona* and some related genera occurring in Colombia. Revista Acad. Colomb. **7**: 404–425. *2 pl. + f. 1–19 + tables 1–5.* Jl 1947.

Mayberry, M. W. *Martynia louisiana* Mill., an anatomical study. Trans. Kan. Acad. **50**2: 164–171. *f. 1–21.* 1947.

Nielsen, Etlar L. Developmental sequence of embryo and endosperm in apomictic and sexual forms of *Poa pratensis.* Bot. Gaz. **108**: 531–534. *f. 1–5.* Je [9 Jl] 1947.

Rollins, Mary L. Photomicrographic comparison of milkweed bast and cotton lint in relation to cell-wall structure of other natural cellulose fibers. Bot. Gaz. **108**: 495–510. *f. 1–27.* Je [9 Jl] 1947.

Scott, Flora Murray & Baker, Katherine C. Anatomy of Washington navel orange rind in relation to water spot. Bot. Gaz. **108**: 459–475. *f. 1–56.* Je [9 Jl] 1947.

Turrell, F. M. Citrus leaf stomata: structure, composition, and pore size in relation to penetration of liquids. Bot. Gaz. **108**: 476–483. *f. 1–4.* Je [9 Jl] 1947.

Venkateswarlu, J. Development of the embryo of *Thymelaea arvensis.* Bot. Gaz. **108:** 581–586. *f. 1–16.* Je [9 Jl] 1947.

Williams, Bert C. The structure of the meristematic root tip and origin of the primary tissues in the roots of vascular plants. Am. Jour. Bot. **34:** 455–462. *f. 1–25.* N [D] 1947.

GENETICS
(including cytogenetics)

Almeida S., Héctor U. Lecciones prácticas de genética—El mejarmiento del maiz. Bol. Inst. Bot. Univ. Cent. [Quito] 5[6-7]: 182–191. *f. 1, 2.* Je 1947.

Hutchinson, J. B., Silow, R. A. & Stephens, S. G. The evolution of *Gossypium* and the differentiation of the cultivated cottons. *i-xi,* 1–161. *pl. 1–8 + f. 1–10 + tables 1, 2.* Oxford University Press. London, 1947.

Lorz, Albert P. Supernumerary chromonemal reproductions: polytene chromosomes, endomitosis, multiple chromosome complexes, polysomaty. Bot. Rev. **13:** 597–624. D 1947.

Smith, Luther. Irregularities in a hybrid between *Triticum durum* and *T. persium.* Jour. Agr. Res. **75:** 301–305. *f. 1, 2 + tables 1–4.* D 1947.

Stebbins, G. L., Matzke, E. B. & Epling, C. Hybridization in a population of *Quercus marilandica* and *Quercus ilicifolia.* Evolution **1:** 79–88. *f. 1–9.* Mr [Jl] 1947.

Sullivan, T. D. Somatic chromosomes of pedigreed hybrid *Petunia.* Bull. Torrey Club **74:** 453–475. *f. 1–29 + tables 1–6.* N 1947.

Witte, *Sister* **Marie Bernard.** A comparative cytological study of three species of the Chenopodiaceae. Bull. Torrey Club **74:** 443–452. *f. 1–18.* N 1947.

PLANT PHYSIOLOGY
(See also under Ecology: Gall)

Baker, George A. & Brooks, Reid M. Effects of fruit thinning on almond fruits and seeds. Bot. Gaz. **108:** 550–556. Je [9 Jl] 1947.

Beale, Helen Purdy & Lojkin, Mary E. A comparison of the infectivity of different preparations of tobacco-mosaic virus with their ability to precipitate specific serum antibody. Contr. Boyce Thompson Inst. **14:** 457–569. *f. 1 + tables 1–4.* Jl–S [N] 1947.

Benedict, H. M., McRary, W. L. & Slattery, M. C. Response of guayule to alternating periods of low and high moisture stresses. Bot. Gaz. **108:** 535–549. *f. 1–4.* Jl [9 Jl] 1947.

Bonner, James & Galston, Arthur W. The physiology and biochemistry of rubber formation in plants. Bot. Rev. **13:** 543–596. *f. 1 + 2 tables 1–3.* D 1947.

Booth, W. E. The thermal death point of certain soil inhabiting algae. Proc. Mont. Acad. **6:** 21–23. 1946 [1947].

Cibes, Hector R., Childers, Norman F. & Loustalot, Armand J. Influence of mineral deficiencies on growth and composition of vanilla vines. Plant Physiol. **22:** 291–299. *f. 1–4.* Jl [Au] 1947.

Curtis, J. T. Studies on the nitrogen nutrition of orchid embryos—I. Complex nitrogen sources. Am. Orchid Soc. Bull. **16:** 654–660. *f. 1–3.* 1 D 1947.

DeRopp, R. S. Studies in the physiology of leaf growth. IV. The growth and behaviour *in vitro* of dicotyledonous leaves and leaf fragments. Ann. Bot. **11:** 439–447. *f. 1–6.* O 1947.

Denny, F. E. Respiration rate of plant tissue under conditions for the progressive partial depletion of the oxygen supply. Contr. Boyce Thompson Inst. **14:** 419–442. *f. 1 + tables 1–8.* Jl–S [N] 1947.

Dibbern, John C. Vegetative responses of *Bromus inermis* to certain variations in environment. Bot. Gaz. **109:** 44–59. S [O] 1947.

Dulaney, Eugene L. & Perlman, D. Observations on *Streptomyces griseus*—I. Chemical changes occurring during submerged streptomycin fermentations. Bull. Torrey Club **74:** 504–511. *tables 1–4.* N 1947.

Dyer, Hubert J. Influence of potassium and sodium on metabolism of peanut cotyledons during germination. Bot. Gaz. **108:** 570–581. *1 f.* Je [9 Jl] 1947

Gibbs, Martin. The chemical relation of the leaf, sheath, and stem of blue panicum, *Panicum antidotale* Retz. Plant Physiol. **22:** 325–327. Jl [Au] 1947.

Hartman, John. The non-flowering character of sweet potatoes of the Jersey type. Plant Physiol. **22:** 322–324. Jl [Au] 1947.

Hervey, Annette Hochberg. A survey of 500 Basidiomycetes for antibacterial activity. Bull. Torrey Club **74:** 476–503. *f. 1–4 + tables 1–5.* N 1947.

Higinbotham, Noe & Powers, E. L. Some factors affecting the relative amounts of pigmentation in *Coccosporium* sp. Am. Jour. Bot. **34:** 483–492. *f. 1–6 + tables 1–5.* N [D] 1947.

Hitchcock, A. E. & Zimmerman, P. W. Response and recovery of dandelion and plantain after treatment with 2,4-D. Contr. Boyce Thompson Inst. **14:** 471–492. *f. 1–5 + tables 1–6.* Jl–S [N] 1947.

Kent, Nancy & Brink, R. A. Growth *in vitro* of immature *Hordeum* embryos. Science **106:** 547, 548. 5 D 1947.

Kramer, Paul J. A viewpoint for plant physiology. Plant Physiol. **22:** 315–321. Jl [Au] 1947.

Kries, Olive H. Persistence of 2,4-dichlorophenoxyacetic acid in soil in relation to content of water, organic matter, and lime. Bot. Gaz. **108:** 510–525. *f. 1–14.* Je [9 Jl] 1947.

Lessler, Milton A. Effect of temperature gradient on distribution of water in apples. Bot. Gaz. **109:** 90–94. *f. 1–3.* S [O] 1947.

McCool, M. M. Availability of phosphorus and potassium of some soil types devoted to pastures in New York. Contr. Boyce Thompson Inst. **14:** 411–417. *tables 1–6.* Jl–S [N] 1947.

Miller, Lawrence P. Utilization of DL-methionine as a source of the oxygen supply. Contr. Boyce Thompson Inst. **14:** 443–456. *f. 1–3 + tables 1–4.* Jl–S [N] 1947.

Murray, Mary Aileen & Whiting, A. Geraldine. A comparison of the effectiveness of 2,4-dichlorophenoxyacetic acid and four of its salts in inducing histological responses in bean plants. Bot. Gaz. **109:** 13–39. *f. 1–15.* S [O] 1947.

Naranjo V., Plutarco. Las heladas y la necrosis friá de las plantas. Bol. Inst. Bot. Univ. Cent. [Quito] 5^{6-7}: 55–170. *illust.* Je 1947.

Pratt, Robertson. Influence of phosphate on stability of crude penicillin. Plant Physiol. **22:** 308–314. *f. 1–3.* Jl [Au] 1947.

Pucher, G. W. *et al.* Studies in the metabolism of crassulacean plants; the effect upon the composition of *Bryophyllum calycinum* of the form in which nitrogen is supplied. Plant Physiol. **22:** 205–227. *f. 1–18.* Jl [Au] 1947.

Quinby, J. R. & Karper, R. E. The effect of short photoperiod on *Sorghum* varieties and first generation hybrids. Jour. Agr. Res. **75:** 295–300. *tables 1, 2.* D 1947.

Ready, Daniel & Grant, Virginia Q. A rapid sensitive method for determination of low concentrations of 2,4-dichlorophenoxyacetic acid in aqueous solution. Bot. Gaz. **109:** 39–44. *f. 1–3.* S [O] 1947.

Scully, N. J. & Domingo, W. E. Effect of duration and intensity of light upon flowering in several varieties and hybrids of castor bean. Bot. Gaz. **108:** 556–570. *f. 1, 2.* Je [Jl] 1947.

Semmens, E. S. Starch hydrolysis induced by polarized light in stomatal guard cells of living plants. Plant Physiol. **22:** 270–278. *f. 1–5.* Jl [Au] 1947.

Sinclair, Walter B. & Eny, Desire M. Ether-soluble organic acids of mature valencia orange leaves. Plant Physiol. **22:** 257–269. *f. 1, 2.* Jl [Au] 1947.

Smith, Frederick G., Langeland, William E. & Stotz, Elmer. The effect of indole-3-acetic acid in the diastase charcoal model system. Plant Physiol. **22:** 300–307. *f. 1–3.* Jl [Au] 1947.

Takahashi, William N. Respiration of virus-infected plant tissue and effect of light on virus multiplication. Am. Jour. Bot. **34:** 496–500. *f. 1, 2 + tables 1–4.* N [D] 1947.

Tubangui, Marcos A & Basaca, Mariano. Notes on the anthelmintic properties of the latex of papaya (*Carica papaya* Linn.) and of ''Isis'' (*Ficus ulmifolia* Lam.). Phillip. Jour. Sci. **77:** 19–24. *tables 1–3.* My 1947.

Wadleigh, C. H., Gauch, H. G. & Strong, D. G. Root penetration and moisture extraction in saline soil by crop plants. Soil Sci. **63:** 341–349. *f. 1–4.* My 1947.

Watson, S. A. & Noggle, G. R. Effect of mineral deficiencies upon the synthesis of riboflavin and ascorbic acid by the oat plant. Plant Physiol. **22:** 228–243. *f. 1–6.* Jl [Au] 1947.

Weaver, Robert J. Reaction of certain plant growth-regulators with ion exchanges. Bot. Gaz. **109:** 72–84. *f. 1–3.* S [O] 1947.

Weinmann, H. Determination of total available carbohydrates in plants. Plant Physol. **22:** 279–290. Jl [Au] 1947.

Wilson, Katherine S. Vitamin patterns in the development of cucurbit fruits. Am. Jour. Bot. **34:** 469–483. *f. 1–6 + tables 1–4.* N [D] 1947.

Wittwer, S. H., Schroeder, R. A. & Albrecht, W. A. Interrelationships of calcium, nitrogen, and phosphorus in vegetable crops. Plant Physiol. **22:** 244–256. *f. 1, 2.* Jl [Au] 1947.

Wynd, F. L. & Noggle, G. R. Effects of selected chemical properties of soils on protein content of Sudan grass. Lloydia **10:** 136–144. *f. 1–22 + tables 1, 2.* Je [S] 1947.

Yarwood, C. E. Water loss from fungus cultures. Am. Jour. Bot. **34:** 514–520. *f. 1–4 + tables 1, 2.* N [D] 1947.

GENERAL BOTANY
(Including Biography)

Aide, Magdalena B., Agcaoili, Francisco & Cochico, Rosa J. *Jatropa curcas* Linn. (tuba) as a source of natural dye. Phillip. Jour. Sci. **77:** 55–60. *tables 1, 2.* My 1947.

Dobzhansky, Th. N. I. Vavilov, a martyr of genetics, 1887–1942. Jour. Hered. **38:** 227–232. *port.* Au [O] 1947.

Ewan, Joseph. [Willis Linn Jepson]. Jour. Wash. Acad. **37:** 414–416. 15 N 1947.

Fitzpatrick, Harry M. Fred Carleton Stewart 1868–1946. Phytopathology **37:** 687–697. *port.* [biblography] O 1947.

BULLETIN OF THE TORREY BOTANICAL CLUB
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THE EMBRYOLOGY OF EPIDENDRUM PRISMATOCARPUM

B. G. L. SWAMY

Nearly seventy years ago, Treub (1879) reported a very interesting type of suspensor development in the embryogeny of *Epidendrum ciliare*. The suspensor of this species consists of a loose mass of a large number of bulged-out cells, the entire structure appearing to be more or less equal to the embryonal mass in volume. Sharp (1912), during his investigations on the orchid embryo sac, made some observations on the early embryo of *E. cochleatum*. Though his treatment is very fragmentary and incomplete, his figures suggest a possibility of the development of a suspensor similar to that of *E. ciliare*, studied by Treub. Thus Treub's record is the only authentic example of the kind till the present day.

In a casual survey of the types of suspensors of orchids, the present writer (1947) found that certain types of suspensor organization were confined in general to specific tribes of the family. Among other points of interest, it was noted that the type of suspensor seen in *E. ciliare* was unique in that a similar type was not encountered in any other genus of the family. Further, it was suggested that an investigation of other members of the tribe Laeliinae would probably reveal the same fundamental pattern of suspensor organization as the one shown by *E. ciliare*, thereby providing additional data for generalizations. Mr. R. S. Wharton of the Biological Laboratories of Harvard University was kind enough to place at my disposal a flowering plant of *E. prismatocarpum* Reichenb., and I hereby express my gratitude to him. The flowers were artificially pollinated and the present study is based on the material obtained therefrom.

Megasporogenesis and Embryogeny. After pollination, mitotic activity becomes suddenly accelerated in the cells of the placental tissue and the placental ridges send out numerous protuberances which repeatedly branch in a dichotomous fashion. Each ultimate branch consists of a filamentous row of 4–6 nucellar cells surrounded by the epidermis. The terminal nucellar cell of each filament differentiates into the archesporium, which directly functions as the megaspore mother cell.

The inner integument originates first, and the outer slightly later when the megaspore-mother cell is passing through the first meiotic division (fig. 1). As in other orchids, the outer integument outgrows the inner, leaving an empty space between at the micropylar end (figs. 4, 5).

The meiotic divisions result in a "row of three cells," the micropylar cell representing the undivided dyad cell and the two others the megaspores (fig.

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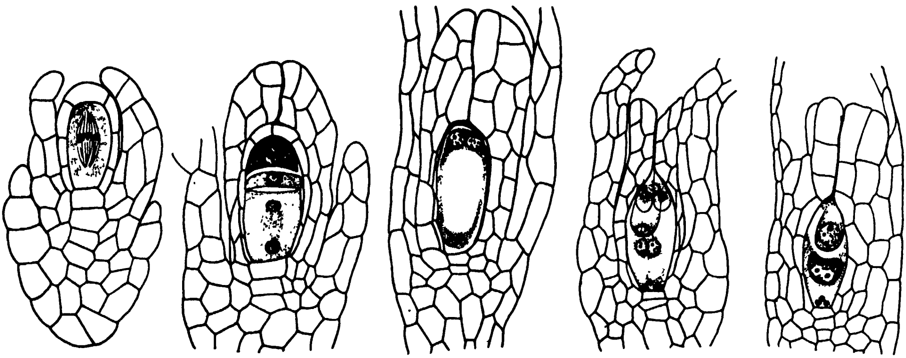
2). The nucleus of the chalazal megaspore divides thrice to give rise to an 8-nucleate embryo-sac. In passing it may be noted that the antipodal nuclei at the 4- and 8-nucleate stages of the embryo-sac appear very much diminished in size (figs. 3, 4).

In *E. variegatum* Sharp (1912) observed occasional instances of the *Adoxa* type of development of the female gametophyte. Judging from his figures (e.g. fig. 8, which shows a pronounced vacuolation, characteristic of a typical 2-nucleate sac of the Normal type) such a condition seems improbable, excepting perhaps as a very rare abnormality. Pfitzer (1880) has not recorded any atypical features in the gametogenesis of *E. ciliare;* nor was I



1 2 3 4 5

FIGS. 1–5. FIG. 1. Megaspore-mother cell in metaphase I; ×1200. FIG. 2. "Row of three cells," the micropylar cell representing the undivided dyad cell, the middle one a megaspore and the chalazal cell representing the 2-nucleate embryo-sac; ×1200. FIG. 3. 4-nucleate embryo-sac; ×1200. FIG. 4. Mature embryo-sac; ×800. FIG. 5. Zygote and the degenerating primary endosperm nucleus; ×800.

able to observe any other type of development excepting the Normal type in the species studied at present.

Double fertilization is accomplished normally but the primary endosperm nucleus promptly degenerates. The zygote (fig. 5) rests for 40–45 days and then divides by a transverse wall (fig. 6*a*). The basal cell divides again in the same plane whereas the terminal cell does so in a vertical plane (fig. 6*b*) to result in a 3-celled tier, the chalazal tier consisting of two cells (fig. 6*c*). Cells constituting the micropylar and middle tiers (suspensor initial cell and the middle cell respectively) by repeated transverse divisions develop into a filament of 8–10 cells (fig. 6*d–h*). Subsequently oblique and vertical divisions occur in the cells of the filament and each resultant cell bulges out (fig. 6*i–k*) so that the mature stage presents the characteristic appearance as illustrated in figure 6l. The cells constituting the chalazal

tier (fig. 6*c*) develop into the embryonal mass proper as depicted in figure 6*d–l*.

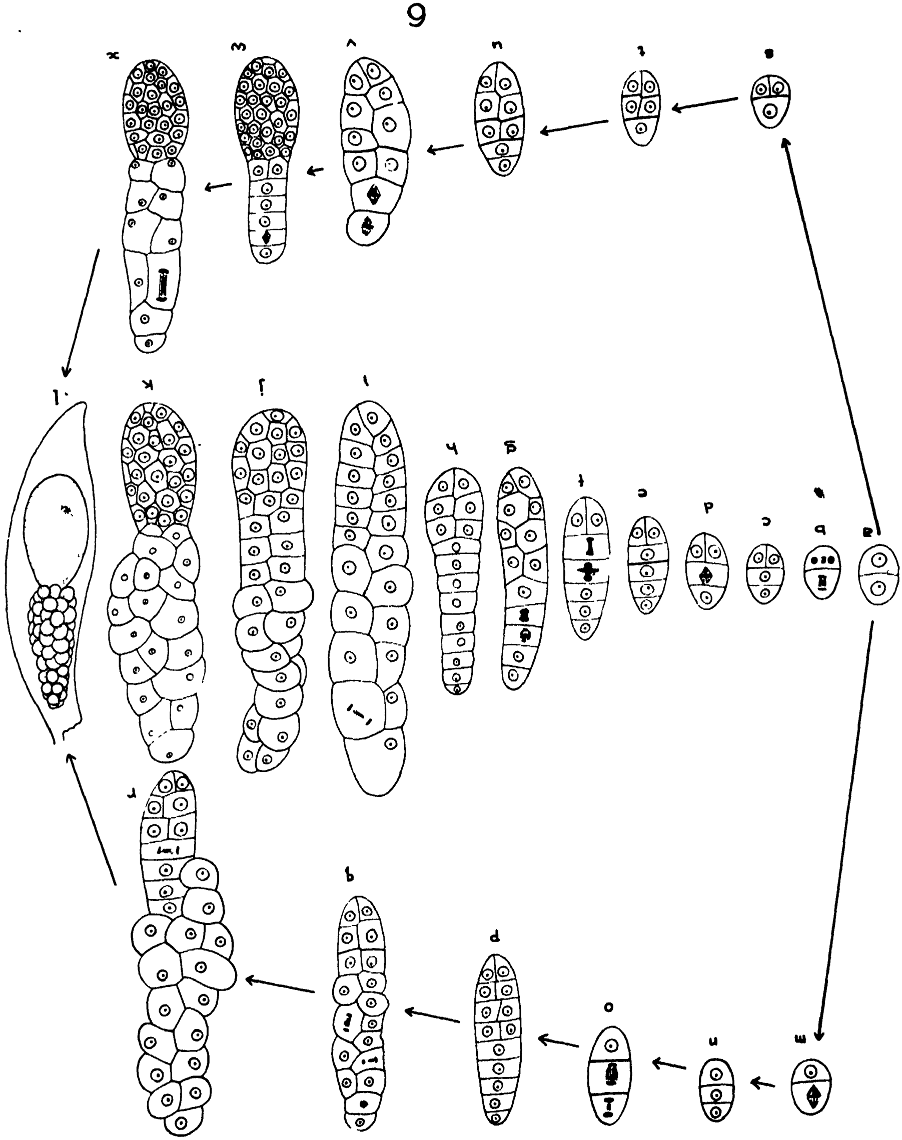


FIG. 6. Figures illustrating the development of the suspensor and embryo. For explanation see text. All figures × 1200, excepting figure *l*, which is × 400.

The behavior of the middle cell (of the stage represented in fig. 6*c*) calls for comment. The difficulty of drawing a line between the suspensor and the

embryo especially during the early stages of development of this pattern has already been expressed by Johansen (in preparation). My observations at present indicate that the derivatives of the middle cell cut off towards the micropylar end join and merge with the suspensor, whereas those adjoining the embryonal mass merge into the embryonal mass proper. In other words, the basal cell of the two-celled proembryo contributes wholly to the suspensor and only partly to the embryonal mass proper, although the part contributed to the latter is very small. Thus, on a broad basis, the type of embryogeny may be said to conform to some variation of the Onagrad Type (see Johansen 1945).

The sequence of development of the suspensor and embryo just described is the general condition met in *E. prismatocarpum*. But an examination of a large amount of material reveals that the above sequence may not always be maintained. It may become upset by (1) a lag in the rate of differentiation of the embryonal mass as compared with its associated suspensor (fig. 6*m–r*), or (2) a lag in the rate of differentiation of the suspensor as compared with its associated embryonal mass (fig. 6*s–x*). The end product, however, in either case will be the same as the one in the general development (fig. 6*l*). This variability in the rate of development of the two structures—suspensor and embryonal mass—of the embryo is often seen in the different ovules of one ovary.

The embryos of all the species of *Epidendrum* thus far investigated—*E. ciliare* (Treub 1879), *E. verrucosum, E. variegatum, E. cochleatum* (Sharp 1912), and *E. prismatocarpum* (present study)—conform to one pattern as described in the present contribution. But Johansen (in preparation) puts *E. variegatum* and *E. cochleatum* under his "*Epipactis palustris pattern,*" *E. verrucosum* under his "*Orchis latifolia pattern,*" and *E. ciliare* under the independent "*Epidendrum pattern.*" This is perhaps because he interprets Sharp's figures 16 (*E. verrucosum*), 17, and 18 (*E. cochleatum*) as showing end products. There does not seem to be any justification either for the above interpretation of Sharp's figures or for considering the patterns of embryogeny to be different and to pigeonhole the species under altogether different heads ("patterns").

I am moved to interpret Sharp's figures only as stages in development, because his figure 17 is very similar to figure 6*j* of the present paper. His figure 18 looks to be that of a fully mature embryo wherein the suspensor, having once developed, has become dried up and disappeared, which condition happens very commonly in orchids. Regarding Johansen's classifying *E. verrucosum* under his "*Orchis latifolia pattern,*" it must be stated that this is not at all justifiable, because the type of embryogeny exhibited by the latter is wholly different from the one shown by the former. *Orchis* (and all the genera of the tribe Ophrydinae thus far investigated) shows a pattern

of suspensor which is unique in the family (Swamy 1946). That is, the suspensor behaves as a typical "extra-ovular haustorium" whereas in the species of *Epidendrum* this organ does not extend out of the limits of the seed cavity. Further, Sharp's figure 16, which apparently has been the basis for the step taken by Johansen, may be best interpreted as representing a stage in development, because this figure very closely resembles figure 6*h* of the present paper. Thus from the available data on hand it may be stated with certainty that all the species of *Epidendrum* studied till now exhibit fundamentally the same type of embryogeny, which character speaks for the uniformity of the genus.

SUMMARY

The embryo-sac of *Epidendrum prismatocarpum* follows the monosporic 8-nucleate type.

The first division of the zygote takes place by a transverse wall. During the second cell generation, the wall laid down in the basal cell is again transverse and that in the terminal cell vertical. The basal cell gives rise to the suspensor and to a small portion of the embryonal mass proper, whereas the terminal cell develops wholly into the embryonal mass. During the development of the suspensor, the basal cell divides to form a filamentous row of cells, which by subsequent oblique and vertical divisions develops into the characteristic mature suspensor, resembling a compact bunch of grapes. Occasionally there may be a lag in the rate of maturation of either the suspensor or of the embryonal mass proper.

All the species of *Epidendrum* so far investigated conform to the same pattern of embryogeny. Johansen's method of treatment of the classification of orchid embryos with regard to *Epidendrum* is not justified.

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Literature Cited

Johansen, D. A. 1945. A critical survey of the present status of plant embryology. Bot. Rev. **11:** 87–107.

————. Plant embryology. [In preparation. The Chronica Botanica Co.]

Pfitzer, E. 1880. Beobachtungen über Bau und Entwicklung der Orchideen. 5. Zur Embryoentwicklung und Keimung der Orchideen. Verh. Nat.-Med. Ver. Heidelberg **2:** 23–30.

Sharp, L. W. 1912. The orchid embryo sac. Bot. Gaz. **54:** 373–385.

Swamy, B. G. L. 1946. Embryology of *Habenaria*. Proc. Nat. Inst. Sci. India **12:** 413–426.

————. 1947. On the suspensor types in orchids and their significance. **Am. Jour.** Bot. **34:** Suppl. 12 a.

Treub, M. 1879. Notes sur l'embryogénie des quelques Orchidées. Verh. Akad. **Amsterdam** Natuurk. **19:** 1-50.

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DIFFERENCE IN FORM AND REACTION TO COLD IN ROOT-TIP AND APICAL BUD CHROMOSOMES OF MEDEOLA[1]

T. M. WOODARD, JR.

Introduction. Darlington and La Cour (1940) showed that the somatic chromosomes of *Trillium* and *Paris* develop numerous understained segments when the plants are grown for an appropriate time at temperatures near 0° C. They found these special segments to be highly specific, both as to location and number within the chromosome and the species. They attributed this reaction to nucleic acid starvation and suggest that the segments represent heterochromatic regions of the chromosomes which are to be identified with the chromocenters of the resting nucleus. This interpretation of the nature of the special segments has been challenged by Resende, de Lemos-Pereira and Cabral (1944), who suggest, in turn, that the special segments are nucleolar zones. Darlington and La Cour found also that the chromosomes of several other plants grown at low temperatures develop no such differential segments but undergo, instead, marked contraction, a type of reaction now well known and, apparently, quite common (see Geitler 1938; Warmke 1946). Darlington and La Cour claim that only in the Parideae is the production of such special segments shown as the effect of cold.

There are a number of accounts of chromosome constrictions produced by cold, special fixatives, special methods of growing the material, or combinations of these factors. These cases are all reviewed by Wilson and Boothroyd (1941). Constrictions have been known to occur sporadically without any assignable cause. In arctic species of certain plants an exceptionally high number of secondary constrictions is to be found normally. Whether or not such constrictions are identical with special segments is uncertain. There is too little information as yet to justify any general conclusions in regard to the specific cause or the exact nature of all such segments. In spite of this uncertainty, however, the rather remarkable specificity as to location and number of the special segments, in *Trillium* at least, constitutes a morphological characteristic. They may thus play a role as specific markers in comparative analysis of chromosome complements. It becomes of interest, therefore, to inquire how the chromosomes of *Medeola*, another member of the Parideae, would react to low temperature. This was the purpose of the work to be described.

[1] The writer is indebted to the Natural Science Division Research Fund, Vanderbilt University, for grants made in support of this work.

Methods. Some 65 rhizomes of *Medeola virginiana* were obtained at Highlands, N. C., in July 1946. They were kept in pots in peat moss in a controlled temperature chamber (about 20° C); after several weeks, when a new crop of root-tips had appeared, the tips and apical buds of some of the plants were prepared for study of the normal chromosomes. Other plants were transferred to a commercial refrigerator in which they stayed for 96 hours. A recording thermometer indicated a temperature within the refrigerator of 1.6° C, with a variation of less than one degree throughout the period of cold treatment. Both treated and untreated buds and tips were fixed in Flemming-Benda fixing fluid and prepared as squashes after being treated by the Feulgen method.

Observations. *Normal Chromosomes.* Figure 2 shows a typical metaphase complement of 14 chromosomes found in apical bud cells. Measurements of the size of the bud chromosomes and calculation of arm-ratios were made for eight chromosomes of each type. These data were found to agree closely with those of Stewart and Bamford (1942), who described the mitotic and meiotic chromosomes of the flower bud of *Medeola*. For details of chromosome form their paper may be consulted.

The untreated chromosomes of root-tips at metaphase and anaphase especially (fig. 6) are strikingly different in form from those of the apical bud (cf. fig. 2). There are a number of accounts in the literature of differences in chromosome form within the individual, but there appear to be few, if any, cases on record in which such differences are as marked as in *Medeola*. While the metaphase chromosomes in the apical bud are relatively short and of considerable breadth, those of the root-tip are much longer and narrower, almost thread-like in form in early pro-metaphase (fig. 4). That this difference in form is a result of difference in the degree of condensation and not in volume is shown by measurements. Four complete metaphase or anaphase groups of each type were drawn and measured, and it was found that the average volume of chromatin was the same in each approximately.

In addition to this form difference, there is another characteristic difference in behavior between apical bud and the root-tip chromosomes. While the metaphase stage in apical bud cells (fig. 2) is characterized by complete chromatid fusion, i.e., temporary disappearance of the line of separation of the two chromatids of each chromosome, in root-tip nuclei chromatid fusion and condensation apparently never advance to this point before separation of chromatids occurs at anaphase. Figure 5 represents a pro-metaphase stage in mitosis in a root-tip. This particular stage, it is believed, was near full metaphase when fixed. For if comparison is made with an anaphase (fig. 6) it will be seen that by anaphase very little, if any, further chromosome contraction has taken place beyond that present in the pro-metaphase stage shown. Comparison of figures 5 and 2 will indicate this difference in behavior during mitosis at the time when it is most marked.

This marked difference between apical bud and root-tip chromosomes in the degree of condensation appears to be in evidence at every stage through-

FIG. 1. Prophase in apical bud cell. FIG. 2. Metaphase in apical bud cell. FIG. 3. Anaphase group in apical bud cell after cold treatment. FIG. 4. Prophase in root tip cell. FIG. 5. Late pro-metaphase in root tip cell. FIG. 6. Anaphase in root tip cell. FIG. 7. Metaphase showing diplochromosomes in root tip cell after cold treatment. All drawings were made with a camera lucida, using a 2 mm. apochromatic objective and a 30 × compensating ocular. The magnification of all figures, after reduction, is 1778 ×.

out the entire mitotic process in the two types of tissue. If one may assume that the amount of relational coiling of the chromatids of each chromosome

serves as an accurate index of the progress of prophase, then prophases which are comparable on this basis always show the same degree of difference in contraction, the chromosomes of the apical bud being at any comparable stage shorter and broader than those of the root-tip (cf. figs. 1 and 4).

Cold-treated Chromosomes. Figure 3 shows the appearance of an anaphasic group of apical bud chromosomes after cold treatment. No difference in length of the cold-treated as compared with the normal chromosomes (cf. figs. 2 and 3) could be detected. There does appear to be a slight increase in the diameter of the treated chromosomes, but this is so small as to be due, possibly, to differences in pressure arising during the squashing process. No diplochromosome groups were found in any of the slides of treated bud chromosomes, and no evidence of polyploidy was observed. A number of apparently normal anaphases were observed, indicating that the temperature at which the plants were grown was not low enough to prevent mitosis.

When treated root-tip chromosomes at metaphase are examined, on the other hand, it is found that marked contraction has been induced. Diplochromosome groups, similar to those observed in many other plants after cold treatment, are frequent (fig. 7). The length and diameter of the individual chromatids are approximately the same as those of the homologous untreated chromosomes of the apical bud (cf., figs. 7 and 2).

Note that in neither the apical bud nor the root-tip chromosomes are any constrictions to be observed after cold treatment other than those present in the untreated chromosomes. The apical bud chromosomes of *Medeola* show neither contraction nor special segment formation after cold treatment. So far as the writer is aware no wholly negative response of this kind to cold has been recorded, except when the temperature was low enough to produce pathological mitosis or to prevent mitosis. The root-tip chromosomes show marked decrease in length with increased chromatid diameter after cold treatment, behaving in this respect like the chromosomes of so many other plants.

Discussion. It has been shown by Resende, De Lemos-Pereira and Cabral (1944) that contraction and the production of special segments as a result of low temperature are not mutually exclusive processes but may occur simultaneously. Special segments appear, according to these authors, only when plants are grown at temperatures below some specific minimum. Since the observations on *Medeola* recorded here were limited to a single temperature, it cannot be concluded that such segments would never appear in this plant. It might be pointed out, however, that the temperature in these experiments was lower than that found necessary to produce such segments in *Trillium* and *Paris*.

In spite of the rather unexpected observation that the chromosomes of *Medeola*, unlike those of the related genera, *Trillium* and *Paris*, develop

no special segments after cold treatment, the preceding observations are of some interest from two other standpoints, namely, that of the difference in form between the chromosomes in different parts of the same organism and that of the difference in behavior of apical bud and root-tip chromosomes at low temperatures.

There are a number of instances on record of inter- and intra-individual variation in chromosome form (for summary see Geitler 1938). Inter-individual differences may in many cases be ascribed clearly to genotypic factors (see Darlington 1937). With regard to intra-individual differences, however, any general explanation of their cause is less evident. If such differences have a common cause, it must obviously be sought in phenotypic factors, such as the speed of the mitotic process, spatial relationships affecting the synthesis of chromosomal substance, alterations of the spiralization cycle, etc.

In the plant *Medeola,* the writer has observed a marked difference in the form of the metaphase chromosomes in the apical bud as compared with those in root-tips. This difference obtains, apparently, throughout the entire mitotic process. When these two tissues are subjected to low temperature at the same time the chromosomes of the root-tip undergo marked contraction; those of the bud, however, show no change. It seems reasonable to infer that the form difference which normally exists in this plant is a result of a different physiological state, related in some way to temperature; this inference appears to be especially justified in view of the fact that the difference in form may be equated by growing the plants at a lower temperature than that to which they are as a whole normally subjected. In view of the difference in form between bud and root-tip chromosomes and their differential behavior to low temperature one wonders whether or not this difference may have resulted as an adjustment on the part of the bud chromosomes to the lower temperature prevailing naturally near the surface of the soil as the buds approach it.

SUMMARY

The root tip chromosomes of *Medeola* are longer and of less diameter than those of the apical bud at comparable stages throughout the entire mitotic process. The volumes of the whole complements are the same. When plants are kept at 1.6° C, for 96 hours the apical bud chromosomes undergo no obvious change in form; those of the root tip undergo condensation until at metaphase they have approximately the same form as bud chromosomes. Diplochromosomes are produced at metaphase in the cells of cold-treated root tips but not in those of apical buds.

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Literature Cited

Darlington, C. D. 1937. Recent advances in cytology. ed. 2. Philadelphia.

Darlington, C. D. & La Cour, L. 1940. Nucleic acid starvation of chromosomes in *Trillium*. Jour. Genet. **40:** 185–213.

Geitler, L. 1938. Chromosomenbau. Berlin.

Resende, F., de Lemos-Pereira, A. & Cabral A. 1944. Sur la structure des chromosomes dans les mitoses des meristemes radiculaires. Port. Acta Biol. **1:** 9–46.

Stewart, R. N. & Bamford, R. 1942. The chromosomes and nucleoli of *Medeola virginiana*. Am. Jour. Bot. **29:** 301–303.

Warmke, H. E. 1946. Precooling combined with chrom-osmo-acetic fixation in studies of somatic chromosomes in plants. Stain Tech. **21:** 87–91.

Wilson, G. B. & Boothroyd, E. R. 1941. The rate and degree of differentiation in the somatic chromosomes of *Trillium erectum* L. Canad. Jour. Res. C. **19:** 400–412.

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A SEARCH FOR VIRUS INHIBITORS AMONG SOIL ACTINOMYCETES ANTAGONISTIC TO BACTERIOPHAGES

ALBERT SCHATZ[1] AND HILDEGARD PLAGER

This report presents the results of tests of the effect of fifty-four antiphage actinomycetes on a rodent-paralyzing virus (MM), and of related studies with bacterial viruses. The work was undertaken because of the relative ineffectiveness of antibiotics and other microbial products against most viruses (1–7). Microorganisms so far studied and reported to antagonize viruses include bacteria (1, 3, 4, 8), a pleuropneumonia-like organism (9), actinomycetes (1, 5, 6), yeasts (8), filamentous fungi (1, 4, 7, 8), and protozoa (10). Reports have appeared describing the effect of agents of synthetic and microbial origin on infections caused by filterable pathogens in animals (11–14) and plants (15–16). Our studies were limited to a group of actinomycetes with known antiphage properties (5, 6). MM (17) was chosen as the test virus for several reasons. It is well suited to experimental studies, induces polymyelitic lesions, and has been extensively studied in this laboratory.

Methods. Mouse brains, stored in glycerol, from the 43d to 48th generations of the MM strain of virus were pooled, ground with sand in salt solution containing 10 per cent infusion broth, centrifuged to remove large particles, and the supernatant fluid employed immediately or after storage in the dry-ice box. Albany mice[2] weighing 10–12 grams were injected intraperitoneally. The majority of animals given 0.05 ml. of a 0.5×10^{-6} dilution of mouse brain were usually dead or paralyzed by the seventh day. Unless otherwise specified, all animals were observed for seven days.

To determine inactivation of the virus by actinomycetes, two parallel streaks of each microorganism were made approximately 15 mm. apart across the center of glycerol–yeast-extract–agar[3] plates seeded with a 10^{-3} dilution of mouse-brain virus, as illustrated in Figure 1. After incubation for 48 and 96 hours at about 28° C, agar discs, removed from between the streaks and from an uninoculated control plate by pressing down with an 11- by 75-mm. test-tube, were triturated with sand in distilled water. The

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[2] A strain used at the Division of Laboratories and Research, New York State Department of Health, Albany, N. Y.

[3] Glycerol 25 ml., yeast extract 3 gm., NaCl 2 gm., K_2HPO_4 1 gm., $MgSO_4$ 0.2 gm., $FeSO_4$ 0.01 gm., agar 15 gm., tap water 1000 ml., about pH 7.0.

supernatant fluid, after centrifugation, was assayed for virus, usually at dilutions of approximately 10^{-5} and 10^{-6} of the original brain material. The final pH of the medium was determined after 96 hours by a drop or two of bromothymol blue indicator placed on the agar surface between the streaks. This procedure was somewhat similar to the virus-seeded agar disc technic

FIG. 1. Method of testing for antagonistic action of soil actinomycetes against MM virus incorporated in an agar medium.

employed by Johnson (18) to determine the effects in vitro of the various chemical agents on tobacco mosaic virus.

The actinomycetes were also grown as stationary cultures in 500-ml. Erlenmeyer flasks containing 100 ml. of peptone-meat extract, glucose-tryptone, and glycerol-yeast extract semisolid broth of the same composition employed for previous studies with bacteriophages (6). After incubation at about 28° C for 10–12 days the cultures were filtered through sterile paper.

In vitro assays were carried out by incubating equal volumes of test material and mouse-brain virus dilutions at room temperature for one hour or overnight, as indicated. Intraperitoneal inocula consisted of 0.05-ml. portions of these mixtures. For toxicity tests two mice were each given intraperitoneally 1-ml. portions of the filtrates twice daily over a 5-day period. The same schedule was followed for in vivo studies with animals infected one hour after the first treatment. Five mice were employed for each in vitro and in vivo assay. Appropriate controls with sterile culture medium and virus were included throughout.

TABLE 1. *Effect of antiphage actinomycetes on MM virus incorporated in agar media.*

Tests after 96 hours' incubation at about 28° C

Actinomyces No.	Agar medium	Final pH of agar	Fate of mice inoculated with virus dilution[a]	
			10^{-5}	10^{-6}
25	Glucose-tryptone	7.6	2/5	4/5
28	" "	7.5	1/5	2/5
44	" "	< 6.0	4/5	3/5
79–D	" "	6.1	0/5	4/5
Control	" "	6.7	0/5	3/5[b]
19–D	Glycerol-yeast extract	7.1	1/5	3/5
43–D	" " "	7.2	1/5	4/5
46–D	" " "	7.4	2/5	3/5
47	" " "	7.3	3/5	3/5
48	" " "	7.0	1/5	0/5
56	" " "	7.2	0/5	2/5
79	" " "	6.7	3/5	2/5
98	" " "	6.1	5/5	5/5
193–B	" " "	6.6	0/5	3/5
A. griseus[c]	" " "	7.2	1/5	2/5
Control	" " "	7.0	1/5	2/5[b]

[a] Numerator = number of unparalyzed survivors; denominator = number of mice inoculated.
[b] 4/5 for 10^{-7}.
[c] Streptomycin-producing strain.

Results. The effect on MM virus, incorporated in agar, of growth of antiphage actinomycetes is recorded in table 1. The data reveal that only by *Actinomyces*[4] sp. 98 was the virus completely inactivated in the two dilutions tested. In view of the marked acidity produced in the medium, and the apparent acid-sensitivity of MM virus in certain buffer solutions (19), this result is of unknown significance. *Actinomyces* sp. 193–B, which produces the antiphage agent active in vitro against fowl pox virus (6), as well as a streptomycin-producing strain of *Actinomyces griseus,* did not demonstrably inactivate the MM strain.

[4] In the 6th edition of Bergey's *Manual of Determinative Bacteriology,* the genus *Actinomyces* has been changed to *Streptomyces.*

Of sixty untreated culture filtrates tested in vivo none was sufficiently active to justify further study, although activity of a very low order such as might be expected in such dilute solutions as culture filtrates may have been present.

Of 124 filtrates which were untreated or adjusted to pH 7.5 before being tested in vitro, only five preparations completely inactivated the dilutions of virus used in the original tests, and these results could not be confirmed with subsequent lots of culture filtrates from the same microorganisms. Loss of antibacterial properties among antibiotic-producing microorganisms is not uncommonly encountered. Variation of the parent cultures, for which actinomycetes are particularly notorious, may also have been a contributing factor.

These inconsistent results with MM virus are similar to the data reported by Jones and others (2) for the effects obtained with culture filtrates of a soil *Trichoderma* and *Actinomyces* on fowl pox virus. In studies on the inactivation of tobacco mosaic virus by bacteria and fungi, Johnson and Hoggan (4) obtained variable results. Schatz (unpublished data) found, that under the same experimental conditions, culture filtrates from different lots of the same antiphage actinomycetes fluctuated considerably in activity against certain bacterial viruses.

Culture filtrates of the streptomycin-producing strain of *A. griseus* were inactive against MM virus. Filtrates from this microorganism have already been shown to be inactive against vaccinia (3). Culture filtrates of the *Actinomyces* and *Trichoderma*, which Jones (2) reported to be effective in some tests against fowl pox, did not inactivate MM virus.

Despite the inactivity of 193–B by the agar-streak test (table 1) and the negative results obtained with culture filtrates, it was considered justifiable to test more completely the agent produced by this microorganism because it was active against fowl pox virus. For this purpose, antiphage fractions were prepared from the mycelium and culture filtrate by methods previously reported (6). At 1:80,000 and 1:50,000, on a dry-weight basis, these preparations caused a 100-fold reduction of *Staphylococcus aureus* phage K by the agar-tube technic (5) with overnight incubation at 37° C. When MM virus was exposed for 24 hours at room temperature to these antiphage preparations adjusted to pH 7.5, the culture filtrate fraction was inactive while only the undiluted mycelial extract inactivated the virus and this weakly (table 2). This activity is of the same order of magnitude as the effect of similarly prepared extracts on fowl pox virus (6). Tests with one lot of a mycelial preparation revealed that the undiluted material was markedly toxic to mice. Comparative studies with actinomycin, chaetomin, penicillin, and streptomycin revealed no activity against the virus. Actinomycin has been reported to be active against fowl pox and chick

laryngotracheitis (2), as well as influenza viruses (20). Chaetomin had never been tried against any virus. Although the inefficacy of penicillin and streptomycin against various viruses is well established, tests with these antibiotics had never been reported for the MM virus.

TABLE 2. *Effects in vitro of antibiotic agents on MM virus.*

24-hour exposure at room temperature

Antibiotic	Experiment No.	$\frac{1}{2}\times10^{-4}$ virus exposed to units per ml.[a]	Fate of mice inoculated with virus dilution[b]		
			$\frac{1}{2}\times10^{-4}$	$\frac{1}{2}\times10^{-5}$	$\frac{1}{2}\times10^{-6}$
Actinomycin	1	12,500	1/5	0/5	0/5
Antiphage agent					
(mycelial extract).[c]	1	1: 80,000[c]			
Undiluted			1/5	5/5	5/5
1: 2			2/5	1/5	2/5
1: 5			0/5	1/5	0/5
Antiphage agent[d] (from culture filtrate)	1	1: 50,000[d]	0/5	0/5	1/5
Chaetomin	2	500	0/5	0/5	1/5
Penicillin	2	20,000	0/5	0/5	1/5
Streptomycin	2	50,000	0/5	1/5	3/5
Broth salt control	1			0/5	0/5[e]
Broth salt control	2			0/5	2/5[e]

[a] $\frac{1}{2}\times10^{-3}$ virus dilution employed with actinomycin.
[b] Numerator = number of unparalyzed survivors; denominator = number of mice inoculated.
[c] 26.4 mg. dry weight per ml. 1: 80,000 dilution on dry-weight basis caused 100-fold reduction in plaque count of *Staph. aureus* phage K by agar-tube technic with overnight exposure at 37° C.
[d] 22 mg. per ml. active at 1: 50,000. See footnote *c* above.
[e] 2/5 for $\frac{1}{2}\times10^{-7}$.

In an attempt to obtain increased activity with *Actinomyces* sp. 193–B, variants were picked as individual, well-isolated plate colonies from 193–Or, the original parent 193 culture, and 193–W and 193–B, the white and brown strains derived from 193–Or. A total of 13 variants in addition to 193–Or, W, and B were selected for testing. These differed markedly in cultural properties (table 3) as well as in antiphage activity (table 4). The data in tables 3 and 4 indicate a correlation of lack of pigmentation in glucose-tryptone medium and absence of aerial mycelium with an acidic reaction and little or no antiphage properties. Conversely, browning of the culture medium and the presence of aerial growth appears more often than not to be associated with alkaline pH and higher antiphage activity.

These results are analogous to those obtained in studies of strain

TABLE 3. *Cultural characteristics of variants of Actinomyces sp. 193–B in tryptone-glucose medium.*

	11-day observations			
Variant[a]	Growth	Presence of of aerial mycelium	Brown pigmentation in medium	pH of culture filtrate
193–Or	++++	+	0	5.8
1	++++	0	0	5.2
2	++++	0	0	5.2
3	++++	0	++	5.1
193–W	++++	+	++++	7.5
4	++++	++	++++	8.0
5	++++	+++	++++	7.9
6	++++	++++	++++	8.0
7	++++	++++	++++	7.9
8	++++	++++	++++	7.8
9	++++	+++	++++	8.0
10	++++	0	++	5.3
193–B	++++	0	0	7.6
11	++++	++++	++++	7.8
12	++++	++++	++++	7.6
13	++++	++++	++++	7.9
Medium control				7.2

[a] Or = original 193 culture; W and B = white and brown strains derived from 193–Or. Variants 1–13 were isolated from Or, W, or B under which the numbers are listed.

specificity with *A. griseus* and *A. lavendulae* (21, 22). With *A. griseus* it was shown that at least for a group of variants obtained from a single parent culture, only those strains characterized by the formation of aerial mycelium and production of an alkaline reaction in the growth medium were able to elaborate streptomycin. Asporogenous, nocardia-like variants produced an acidic reaction and no streptomycin. A somewhat similar phenomenon was demonstrated for *A. lavendulae* and the antibiotic streptothricin.

In order to study as widely different strains of 193–Or as possible, 193–1, 193–8, 193–9, and 193–13 were selected because they varied markedly with respect to aerial mycelium, pigment production, reaction, and activity against bacteriophages. Glucose-tryptone culture filtrates of these variants were incubated with virus for one hour at room temperature. The results, which are not presented here, revealed no demonstrable reduction of infectivity. These strains, therefore, yielded culture filtrates without significant antiviral activity. Similar results had been obtained previously with glucose-tryptone culture filtrates from 193–Or, W, and B. No attempt was made to prepare and test extracts from the mycelium and filtrates of the variants.

TABLE 4. *Antiphage properties of variants of Actinomyces sp. 193–B grown in tryptone-glucose medium.*

11-day culture filtrates

Variant	Phage survival after exposure to filtrate dilution[a]							
	Staph. aureus phage K				*E. coli* phage T2			
	1: 2	1: 20	1: 100	1: 200	1: 2	1: 20	1: 100	1: 200
193–Or	AB	+	+	++++	+	++	+++	++++
1	0	+++	++++	...	++++	...	...	...
2	0	+++	++++	...	++++	...	...	...
3	0	++++	...	...	++++	...	...	...
193–W	0	0	0	++	0	+	++	++++
4	AB	+	++++		++++	...	...	...
5	0	++	++++	...	0	+	++	++++
6	0	++	++++	...	0	+	+++	++++
7	0	+	++++		+	+++	++++	...
8	0	0	+	+[b]	0	+	++	++++
9	+	++	...	...	0	+	+++	++++
10	0	++++	...		++++	...	...	...
193–B	0	+	++	++++	++	++++	...	...
11	0	+	+++	++++	+	+	++	++++
12	0	0	++++		+	++	+++	++++
13	0	++	++++		0	+	++	++++
Medium control	++++	...	...	...	++++	...	...	...

[a] AB = antibacterial; ++++ = normal plaque count; ++ = approximately a 10-fold reduction; + = about a 100-fold reduction; 0 = complete inactivation (no viable phage).
[b] ++++ at 1: 1000.

SUMMARY

This report presents the results of a search for inhibitors of MM virus among soil actinomycetes antagonistic to bacterial viruses.

By an agar-streak technic, fourteen actinomycetes exhibited no antiviral activity which could not be attributed to the production of an unfavorable pH.

None of sixty culture filtrates tested in vivo was sufficiently active to justify further study. Five out of 107 filtrates tested in vitro were appreciably active in the original assays, but attempts to reproduce these results yielded less or no activity.

When undiluted, the antiphage agent extracted from the mycelium of *Actinomyces* sp. 193–B and shown in previous studies to be active against fowl pox virus was found to exert in vitro a slight effect against the virus. Under similar conditions, actinomycin, chaetomin, penicillin, and streptomycin were inactive.

Attempts to obtain increased activity from *Actinomyces* sp. 193–B by testing growth filtrates of variants which differed culturally and physio-

logically were unsuccessful. However, certain correlations between strain specificity and production of antiphage substances were observed.

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Literature Cited

1. **Linhares, H.** Substâncias antibióticas; ação dos filtrados de cogumelos e bactérias sôbre o virus amarilico de nectrotrópico. Rio de Janeiro. O Hospital **26:** 327–397. 1944.
2. **Jones, D., Beaudette, F. R., Geiger, W. B. & Waksman, S. A.** A search for virus-inactivating substances among microorganisms. Science **101:** 665–668. 1945.
3. **Ramon, G. & Richou, R.** Les complexes antagonistes des filtrats de *Penicillium notatum*, d'*Actinomyces griseus*, de *B. subtilis* et leur action in vitro sur le virus de la vaccine. Compt. Rend. Acad. Paris **224:** 1407–1410. 1947.
4. **Johnson, J. & Hoggan, I. A.** The inactivation of the ordinary tobacco-mosaic virus by microorganisms. Phytopathology **27:** 1014–1027. 1937.
5. **Jones, D. & Schatz, A.** Methods of study of antiphage agents produced by microorganisms. Jour. Bact. **52:** 327–335. 1946.
6. **Schatz, A. & Jones, D.** The production of antiphage agents by actinomycetes. Bull. Torrey Club **74:** 9–19. 1947.
7. **Katznelson, H.** Bacteriophage and the legume bacteria. Trans. 3rd. Comm. Int. Soc. Soil Sci. **A:** 43–48. 1939.
8. **Rakieten, M. L., Rakieten, T. L. & Doff, S.** The absorption of *Staphylococcus* bacteriophages. Jour. Bact. **32:** 505–518. 1936.
9. **Van Herick, W. & Eaton, M. D.** An unidentified pleuropneumonialike organism isolated during passages in chick embryos. Jour. Bact. **50:** 47–55. 1945.
10. **Evans, C. A.** [Personal communication, June, 1947.]
11. **Heilman, F. R. & Herrell, W. E.** Penicillin in the treatment of experimental ornithosis. Proc. Staff Meet. Mayo Clinic **19:** 57–65. 1944.
12. **Parker, R. F. & Diefendorf, H. W.** Effect of penicillin on certain viruses Proc. Soc. Exp. Biol. Med. **57:** 351–354. 1944.
13. **Meiklejohn, G., Wagner, J. C. & Beveridge, G. W.** Studies on the chemotherapy of viruses in the psittacosis-lymphogranuloma group. 1. Effect of penicillin and sulfadiazine in chick embryos. Jour. Immunol. **54:** 1–9. 1946.
14. **Wiseman, R. W., Meiklejohn, G., Lackman, D. B., Wagner, J. C. & Beveridge, G. W.** Studies on the chemotherapy of viruses in the psittacosis-lymphogranuloma group. 2. Effect of penicillin and sulfadiazine on seven strains in mice. Jour. Immunol. **54:** 9–16. 1946.
15. **Stoddard, E. M.** Inactivating *in vivo* the virus of X disease of peach by chemotherapy. Phytopathology **32:** 17. 1942. [Abstract.]
16. **Spizizen, J.** Some preliminary studies on the mechanism of virus multiplication. Proc. Nat. Acad. **29:** 109–114. 1943.

17. **Jungsblut, C. W., & Dallderf, G.** Epidemiological and experimental observations on the possible significance of rodents in a suburban epidemic of poliomyelitis. Am. Jour. Publ. Health **33**: 169–172. 1943.

18. **Johnson, J.** Chemical inactivation and the reactivation of a plant virus. Phytopathology **31**: 679–701. 1941.

19. **Schatz, A., & Plager, H.** The effect of pH on MM virus. [To be published.]

20. **Robinson, H. J.** Some toxicological, bacteriological, and pharmacological properties of antimicrobial agents produced by soil micro-organisms. Thesis. Rutgers University, 46p. 1943.

21. **Schatz, A. & Waksman, S. A.** Strain specificity and production on antibiotic substances. 4. Variations among actinomycetes with special reference to *Actinomyces griseus*. Proc. Nat. Acad. **31**: 129–137. 1945.

22. **Waksman, S. A. & Schatz, A.** Strain specificity and production of antibiotic substances. 6. Strain variation and production of streptothricin by *Actinomyces lavendulae*. Proc. Nat. Acad. **31**: 208–214. 1945.

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FERNS AND FLOWERING PLANTS OF BEAVER ISLAND, LAKE SUPERIOR, MINNESOTA

OLGA LAKELA

Introduction. The study of Beaver Island was undertaken for the enjoyment of collecting and knowing its flora. It is an inviting island of jagged rocks with a well developed vegetation cover. The island is privately owned but it has never been inhabited. The simple cabin in the shelter of the trees and the improved rock-landing for pleasure trips are the only traces of human activity.

In studying the flora, altogether seven collecting trips were made between the years of 1944 and 1947. An attempt was made to cover the area at intervals during the growing season. Therefore, one trip was made each May, June, July, and September, and three in August. To gain knowledge on winter conditions, a single trip was made in early March of 1945, when a severe freezing of the lake made crossing by ice possible. However, one could only view the ice-covered shore from the lake ice. Deep snow made climbing impossible.

Since it was not possible to land on the island during high wave action, the collecting trips were conditioned by the weather and the schedule of the busy fishermen who serviced motor boats. The writer is grateful to the following companions who at different times shared the pleasure of collecting and assisted especially in making nesting records of bird life: Miss Mary I. Elwell, Miss Evelyn Jones, Mrs. Arthur Roberts and son Henry, Mrs. Richard Northrup, all of Duluth, and Dr. Ethel Sue Horton, St. Olaf College, Northfield, Minnesota.

Location and Description. Beaver Island in Lake Superior is situated at 47½° N latitude, and 91¼° W longitude. Four acres in area, it is the largest of the five islands between East Beaver Bay and the Palisade Head, Lake Co. About 1250 ft. from the shore directly across from the White Rock Resort, its elevation rises to some 50 ft. above the lake level. The island, elliptical in outline, the longer axis of some 1100 ft., twice the length of the shorter, parallels the lake shore.

The rock mass is white, containing anorthosite largely, and dark diabase, similar in color and texture to the shore rocks and the outcrops of white rock on the high range of hills northwest.

In contour the chief rock mass appears to be a continuous fold broken into ledges and cliffs about the shores, forming a number of rock pools near

the lake level, and at least two permanent pools near the summit level. The southwest end of the island consists of two points with a cleft between them extending down to the lake level. Lakeward the rocks slope at an angle of about 45°. They are bare to the summit level except in sheltered clefts and niches. A part of the side facing land is a vertical cliff with lichen mats inaccessible to the collector.

Faunistic Aspects. The chief faunistic attraction on the island is the herring gull, *Larus argentatus smithsonianus,* nesting in a colony. The bulky nests of coarse vegetation are constructed mostly on exposed ledges, some time in April. Each nest usually has three eggs. The population count of the colony on May 26, 1945, established a record of 160 nests containing 327 eggs altogether, and 30 young, a few days old. During various trips the red-breasted merganser, *Mergus serrator,* has been observed swimming or in flight around the island. On June 22, 1946, three nests within bushy arborvitae were located, containing nine, eight and seven eggs respectively.

The island may serve as a resting spot for migrating birds. Shore birds, sparrows, and warblers have been observed there. The fruits of the mountain ash, remaining on the trees through the winter and the spring until the new growth of buds, attracts flocks of robins and cedar waxwings.

In the rock pools tadpoles have been observed during the summer trips. The adult frog collected was determined as *Rana sylvatica* var. *cantabrigensis.* No attempt was made to collect insects. The presence of species of mice was not noted before 1947, during the last trip, but no collections were made. It is the only mammal observed.

Vegetation. The shallow soil on the rocks supports a birch-conifer forest with an undergrowth of shrubs and herbs typical of the area. The stand of *Pinus Strobus* constitutes one-third of the sizable conifers which include *Picea glauca, P. mariana, Abies balsamea,* and *Thuja occidentalis.* The last named species is largely represented as young bushy crevice trees. The chief deciduous trees are *Betula papyrifera, B. cordata,* and *Sorbus subvestita.* A thicket of young *Populus deltoides* occurs on high rocks in the grassy border of the tree cover.

The shrub stratum dominated by *Alnus crispa* is well developed under the trees. Associated taller shrubs are *Cornus stolonifera, C. Baileyi, Amelanchier sanguinea,* and *Sambucus pubens.* In the more exposed situations of the rock clefts occur *Rosa acicularis, Diervilla Lonicera, Spiraea alba, Rubus strigosus,* and three species of *Ribes.* The chief shrubby components of the heath mat in crevices, on ledges are species of *Vaccinium, Arctostaphylos; Ledum groenlandicum, Chamaedaphne calyculata, Potentilla fruticosa,* and *Salix Bebbiana* grow in rock clefts about the pools and shoreline.

The herb stratum under shrubs is dominated by *Lycopodium annotinum; Cornus canadensis* and *Viola incognita* are well represented in shady situa-

tions, where also occur large clumps of *Dryopteris spinulosa,* and colonies of *Lycopodium obscurum* var. *dendroideum.* On top ledges in deep lichen mats occur *Lycopodium Selago,* rarely encountered in the state, and its more common var. *patens.*

The principal herbs in full flower in the vernal aspect as observed on May 26, 1945, were the two species of *Primula, Pinguicula vulgaris, Coptis groenlandica,* and *Saxifraga virginiensis.*

Distribution and Noteworthy Species. The clear-cut pattern of the whole flora, as studied by intensive collecting is traceable to its sources in the flora of the nearby mainland. The disseminules of the established flora may be carried by winds, waves, and lake currents or by birds. Ten of the twelve species of composites have wind-borne fruits; the grasses and sedges are probably water-borne, reaching the clefts on highest rocks by the pounding surf which hurls spray high against the sloping cliffs. However, at least three different entities cannot be matched in the flora of the nearby mainland: *Carex deflexa,*[1] only recently collected in Minnesota, and *Campanula rotundifolia* var. *intercedens* f. *cleistocodona,*[2] the sterile clone filling a single rock fissure on the island. Noteworthy is also the typical variety of *Lycopodium Selago,* the second known locality in the state.

POLYPODIUM VIRGINIANUM L. *5761,* a small colony on a shady ledge, southwest end of the island.

ATHYRIUM ANGUSTUM (Willd.) Presl. *5706, 5759,* in rock clefts west side of the island.

DRYOPTERIS DISJUNCTA (Rupr. ex Schur.) Morton. *5756,* common on shady ledges and in crevices; *6195* approaches *D. Robertiana* in leaf form, but lacks glandulosity.

DRYOPTERIS PHEGOPTERIS (L.) C. Chr. *5757,* less abundant than the preceding species.

DRYOPTERIS FRAGRANS (L.) Schott. var. *remotiuscula* Komarov. No coll., rare in fissures of an inaccessible shore cliff.

DRYOPTERIS SPINULOSA (O. F. Mueller) Watt. *5758; 6070; 6196,* large luxuriantly growing plants under the tree cover.

CYSTOPTERIS FRAGILIS (L.) Bernh. *7569,* sparingly represented in fissures southwest end.

WOODSIA ILVENSIS (L.) R. Br. *5760,* common in exposed situations.

OSMUNDA CLAYTONIANA L. *5720,* a sterile leaf collected from a plant in moss border of rock pool, near the summit.

OSMUNDA CINNAMOMEA L. *5744,* a sterile leaf from a plant on low rock ledge east side of the island.

LYCOPODIUM SELAGO L. *6063,* typical form growing in lichen mats on the top-most ledge, near the center of the island.

[1] **Lakela, Olga.** Rhodora 43: 154–156. 1941. Notes on the flora of Minnesota with new records and extensions of ranges.

[2] **Lakela, Olga.** Rhodora 47: 391–392. 1945. A new form of *Campanula* from Minnesota.

LYCOPODIUM SELAGO var. PATENS (Beauv.) Desv. *5776,* growing with the typical form and also on lower ledges, being more common.

LYCOPODIUM ANNOTINUM L. *5781, 6061,* the dominant plant in the ground cover under trees and shrubs.

LYCOPODIUM CLAVATUM L. *6187,* uncommon growing with the preceding species.

LYCOPODIUM OBSCURUM L. var. DENDROIDEUM (Michx.) D. C. Eaton. *5779,* fairly abundant.

LYCOPODIUM COMPLANATUM L. var. ELONGATUM Vict. *6077,* a few plants only.

PINUS STROBUS L. *5938,* large trees conspicuous in the stand of conifers, the only species of pine on the island. One tree was badly infected with ripe aecia of *Cronartium ribicola.* Rust spots were observed on leaves of *Ribes glandulosum.*

PICEA GLAUCA (Moench) Voss, represented by large trees of two color phases, *5939* from a tree with greenish aspect; *5941* from one with bluish aspect, as observed in late May. The color difference is less pronounced in later summer and fall, almost indiscernible.

PICEA MARIANA (Mill.) B.S.P. *5940,* small trees only and less common than the preceding species.

ABIES BALSAMEA (L.) Mill. *5949,* vigorously growing young trees.

THUJA OCCIDENTALIS L. *5745,* some large trees but mostly young bushy forms in exposed clefts, and ledges.

AGROSTIS SCABRA Willd. *5715,* in moist moss mats about rock pools and shores.

CALAMOGROSTIS CANADENSIS L. *5734, 6058,* the most abundant grass in shady and exposed situations.

CALOMOGROSTIS INEXPANSA A. Gray. *5719, 6073,* in exposed crevices of the highest rocks; appears stout and stiff.

DANTHONIA SPICATA (L.) Beauv. *5786,* in dry lichen mats crest of ledges.

DESCHAMPSIA CAESPITOSA (L.) Beauv. *5750,* common in seams of shore rocks.

FESTUCA SAXIMONTANA Rydb. *6082,* in lichen mats under pine trees.

POA COMPRESSA L. *6358,* common in rock seams.

POA GLAUCA Vahl. *5703,* in crevices of high rocks.

POA INTERIOR Rydb. *6078,* growing generally about the shrub border.

POA PALUSTRIS L. *5704,* in moist moss mats about rock pools.

POA PRATENSIS L. *7078,* in moss mat front of the cabin.

TRISETUM SPICATUM (L.) Richter. *5716,* occasional in vegetation mats of high rocks.

SCIRPUS CAESPITOSUS L. *5721,* well established in crevices of shore rocks.

SCIRPUS CYPERINUS (L.) Kunth. var. PELIUS Fern. *5739,* only a few plants on shores of rock pools.

CAREX CRAWFORDII Fern. *6053,* one plant in moist moss mat.

CAREX CANESCENS L. *6055,* rare, under shrubs.

CAREX BRUNNESCENS (Pers.) Poir. *6054,* rare, under shrubs.

CAREX DISPERMA Dewey. *5738,* in moist hollow under pine trees.

CAREX LENTICULARIS Michx. *5737,* moss border of rock pools.

CAREX TONSA (Fern.) Bicknell. *6093,* a few plants in post mature condition from grass mats along the shrub border.

CAREX UMBELLATA Schkuhr. *6353,* in dry lichen mats under pines.

CAREX DEFLEXA Hornem. *6318,* in lichen and moss mats, rocky top, border of shrubs.

JUNCUS BREVICAUDATUS (Engelm.) Fern. *5789,* in moist moss mats, on a ledge near top level.

CLINTONIA BOREALIS (Ait.) Raf. *5762,* sparingly represented; under pines.

MAIANTHEMUM CANADENSE Desf. *5773,* with preceding species; more common.

SALIX BEBBIANA Sarg. *5942,* poorly growing shrubs in rock clefts.

POPULUS TREMULOIDES Michx. *6352,* a thicket of young trees in a grassy opening, southwest end of the island.

BETULA PAPYRIFERA Marsh. *5778,* many large trees.

BETULA CORDIFOLIA Regel. *6351,* large trees; less common than the preceding species.

ALNUS CRISPA (Ait.) Pursh. *5713,* the chief shrub in the undergrowth.

RUMEX MEXICANUS Meisn. *5748,* a few plants on a low ledge west side.

POLYGONUM LAPATHIFOLIUM L. *5746,* northeast side on top rocks.

POLYGONUM CONVOLVULUS L. *7270,* a single plant in grass mat, southeast side.

POLYGONUM CILINODE Michx. *5747,* among shrubs on top ledges.

CHENOPODIUM LEPTOPHYLLUM Nutt. *6181,* in moist grass mats.

STELLARIA LONGIFOLIA Muhl. *6052,* matted colonies on exposed ledges.

THALICTRUM sp. No coll., a single flowerless plant in crevice of steep cliff.

COPTIS GROENLANDICA (Oeder) Fern. *5809,* in sphagnum border of a rock pool near the summit.

ACTAEA RUBRA (Ait.) Willd. *6191,* a few plants among grasses under conifers, southwest end.

CORYDALIS SEMPERVIRENS (L.) Pers. *6051,* in moss mats of exposed ledges.

RIBES GLANDULOSUM Weber. *5926,* frequent in crevices along the shrub border.

RIBES OXYCANTHOIDES L. *5809,* with the preceding species; less abundant.

RIBES TRISTE Pall. *5297,* in shady situations under shrubs.

SAXIFRAGA VIRGINIENSIS Michx. *5929,* in the vernal aspect dominates the moss mats on southeast-facing ledges by vigorous growth of flowers; toward later summer scarcely discernible.

SPIRAEA ALBA Du Roi. *5741,* frequent, in rock clefts.

SORBUS SUBVESTITA Greene. *5714,* large trees.

AMELANCHIER SANGUINEA (Pursh) D.C. *5785,* a few shrubs with diseased foliage and fruit.

POTENTILLA FRUTICOSA L. *5705,* common on shore ledges.

POTENTILLA MONSPELIENSIS L. *5841,* on exposed rocks.

POTENTILLA TRIDENTATA Ait. *5847,* common in rock seams.

RUBUS PUBESCENS Raf. *5928,* a few plants under shrubs.

RUBUS STRIGOSUS Michx. *5728,* common on southeast side.

ROSA ACICULARIS Lindl. *5742*, common in the shrub border, east side.
VIOLA ADUNCA J. E. Smith. *5925*, in crevices of southeast-facing rocks.
VIOLA INCOGNITA Brainard. *5783*, in moist hollow under pine trees.
EPILOBIUM ANGUSTIFOLIUM L. *5768*, common in the shrub border.
EPILOBIUM ADENOCAULON Haussk. *5770*, on shore ledges.
ARALIA HISPIDA Vent. *5763*, in moss mats of exposed ledges.
ARALIA NUDICAULIS L. *5764*, in shady situations.
CARUM CARVI L. *6193*, a single rosette not in bloom near the boat landing.
CORNUS CANADENSIS L. *5754*, growing generally under the tree cover.
CORNUS BAILEYI Coulter & Evans. *6076*, well growing shrubs on high rocks.
CORNUS STOLONIFERA Michx. *5755*, more common than the preceding species.
PYROLA ELLIPTICA Nutt. *5775*, a few plants under pines.
PYROLA SECUNDA L. *5774*, a few plants with the preceding species.
ARCTOSTAPHYLOS UVA-URSI Spreng. *6185*, on high ledges, southeast-facing rocks.
ARCTOSTAPHYLOS UVA-URSI var. COACTILIS Fern. & MacBride. *6084*, with the preceding species.
CHAMAEDAPHNE CALYCULATA (L.) Moench. *5742*, in clefts of shore rocks.
LEDUM GROENLANDICUM Oeder. *5933*, with the preceding species.
VACCINIUM CANADENSE Kalm ex Richards. *6218*, on high ledges in the shrub border.
VACCINIUM PENNSYLVANICUM Lam. *6184*, with the preceding species.
VACCINIUM PENNSYLVANICUM var. MYRTILLOIDES (Michx.) Fern. *6219*, with the typical form.
PRIMULA INTERCEDENS Fern. *5931; 5767, 6066*, in moss border of rock pool.
PRIMULA MISTASSINICA Michx. *5932; 6065, 6090*, with the preceding species and vegetation mats about shore pools.
TRIENTALIS AMERICANA (Pers.) Pursh. *5772; 5944*, in *Sphagnum* border of rock pool.
EUPHRASIA HUDSONIANA Fern. et Wieg. *5732*, on low shore ledge west side.
PINGUICULA VULGARIS L. *5731, 5711*, in *Scirpus* mats around rock pools.
GALIUM TRIFLORUM L. *5782*, a few plants among grasses under shrubs.
DIERVILLA LONICERA Mill. *5719*, a few shrubs on southeast-facing rocks.
SAMBUCUS PUBENS Michx. *5787*, a few shrubs in exposed situations.
LINNAEA BOREALIS L. var. AMERICANA (Forbes) Rehder. *5766*, sparingly growing in lichen mats and sphagnum border of pools.
CAMPANULA ROTUNDIFOLIA L. var. INTERCEDENS (Witasek) Farw. *6092*, common in crevices under all exposures.
CAMPANULA ROTUNDIFOLIA var. INTERCEDENS f. CLEISTOCODONA Lakela. *5777*, in a single rock fissure, southeast end of the island.
SOLIDAGO JUNCEUS Ait. *6180*, in grass mats under shrubs.
SOLIDAGO HISPIDA Muhl. *5707*, on exposed ledges.
SOLIDAGO ULIGINOSA Nutt. *5840*, about rock pools.
ASTER CILIOLATUS Lindl. ex Hooker. *6178*, along the shrub border.

ASTER MACROPHYLLUS L. *6179*, with the preceding species.

ASTER UMBELLATUS Mill. var. PUBENS Gray. *5740*, among shrubs.

ACHILLEA LANULOSA Nutt. *5771*, on exposed ledges.

MATRICARIA SUAVEOLENS (Pursh) Buchen. *5749*, low shore ledge on west side.

PETASITES PALMATUS (Ait.) Gray. *6081*, sterile plants under pines.

TARAXACUM PALUSTRIS (Lyon) Lam. var. VULGARE (Lam.) Fern. *6192*, on high ledge.

LACTUCA sp. A single rosette, a leaf collected, *6194*, not determined.

HIERACIUM CANADENSE Michx. *5765*, common in vegetation mats, east side.

SUMMARY

The plant population of the four-acre island constitutes 117 species of ferns and flowering plants. Ferns and lycopods together include 16 species; the conifers, the dominant tree type, 5 species; the monocots, 25 species having the largest representation by grasses and sedges, 12 and 10 species respectively; of the dicots (71 species), *Rosaceae* and *Compositae* are best established, including 10 and 12 species respectively.

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ADDITIONAL PLANTS OF EL SALVADOR

MARGERY C. CARLSON

About 1000 species of plants, representing 123 families, were collected in El Salvador between January 10 and March 10, 1946, for the herbarium of the Chicago Natural History Museum. Dr. Paul C. Standley, Curator of the Museum, visited El Salvador between December 20, 1921, and May 7, 1922, and with Salvador Calderón made the collections which were reported in their "Lista Preliminar" (2). Since then, brief articles have been published by Anton Kovar (1), and by J. M. Tucker and C. H. Muller (3). The present account deals with some species not previously reported for El Salvador by these authors. The identifications were made by Dr. Paul C. Standley and Dr. Julian Steyermark.

El Salvador is a small country (13,000 sq. mi.) lying southeast of Guatemala and south of Honduras. It is densly populated (about 2,000,000) and extensively cultivated; hence the areas where natural vegetation can be found are limited to places where cultivation is not possible, such as roadside hedges, river valleys, and the tops of the volcanoes and mountains.

The long axis of the country lies almost east and west. An irregular range of volcanic mountains extends across the country, parallel to the coast, and higher mountains lie on the Honduran and Guatemalan boundaries. The plateau between these ranges is very mountainous. The eastern part is lower and more level and is hotter and dryer than the rest of the country. One large river, the Lempa, traverses the country in a sweeping S-shaped curve.

The year is divided about equally between the rainy and the dry seasons, the rainy season occurring between May and October, the dry season between November and April. About 80 inches of rain fall per year. The collections reported here were made in the dry season, and the only moist places visited were the shores of lakes and the tops of the mountains where clouds rest much of the time.

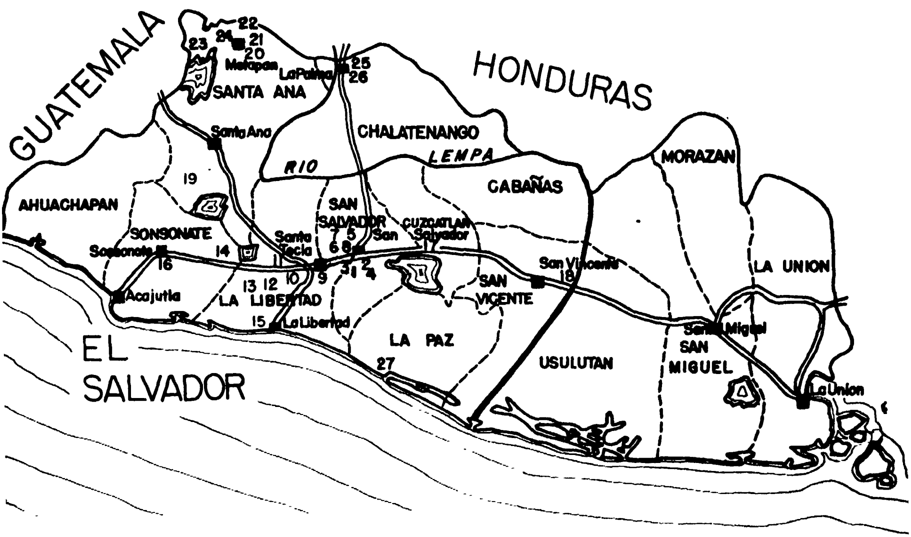
The accompanying map shows the departments, the principal towns and roads, the larger lakes and the Lempa River. The places where collections were made are marked with arabic numbers, and are briefly described below.

I. Department of San Salvador, vicinity of the capitol, San Salvador.

1. San Marcos, a neighboring village to the s.e. Alt. 2600 ft.[1] Narrow road with high almost perpendicular moist banks, up a steep hill and then along paths through a coffee plantation to the summit. January 10.

[1] The elevations were determined with an altimeter and are probably accurate within 200 feet.

2. Los Planes, s. of San Salvador. Alt. 3500 ft. Vicinity of Balboa Park in the untended grassy areas under trees many of which were planted, and along steep roadside embankments. January 11.
3. Banks of the river Acelhuate s.e. of the capitol. 2300 ft. Along river, bordered by steep slopes with dense tangle of shrubs and vines part of the distance, and by grassy meadows in other places. January 13.
4. Cerro Chulo, beyond Los Planes. Highest hill s. of San Salvador. Alt. 4000 ft. A small patch of native vegetation on the s.e. slope just below its summit, somewhat disturbed by cattle. The peak is rocky and windswept. January 28.
5. Volcano of San Salvador. From Finca Florencia to south rim of crater. Alt. 6200 ft. Trail up a steep grassy slope, through coffee plantation for a little way to a main road, which ends at a park and from which narrow trails lead off in both directions along the rim of the crater. January 30.



6. Crater of the Volcano of San Salvador. Along trails on steep, rocky, sparsely wooded slopes inside the crater and on its grassy floor. Alt. of floor, 4700 ft. February 2.
7. Volcano of San Salvador. Road from Finca Florencia to base of peak on its west side, then up through coffee plantation to a very dense forest on the steep slope. Alt. 6300 ft. Forest dark and damp, soil loose, much leaf mould. Trees, mostly oaks, covered with epiphytes. January 31.
8. Same as 7, but from Finca Las Brumas along trail, which is on s.w. side, to peak. Alt. 6700 ft. This side has been cleared and has many cultivated fields almost to the top. The oak forest described in 7 extends to the top. The slopes are precipitous. February 3.

II. Department of La Libertad.

9. Finca El Paraiso, on n. slope of mountain, one-fourth mile s. of Santa Tecla. Alt. 3200 ft. Paths through the coffee plantation, with several undisturbed gorges; along a grassy road on the ridge (alt. 3800 ft.) and along a road to the south toward Manzano. January 14.
10. Finca Los Naranjos, one-half hour by truck s.w. from Santa Tecla. Alt. 3900 ft. Road through coffee plantation to a stream and then along the small canyon of the stream with dense and rank vegetation (tree-ferns, aroids, etc.). January 16.
11. Finca Santa María, w. of Santa Tecla, near Colon, and the valley of the river

Colon. Alt. 2500 ft. River valley 50 to 75 feet wide, banks steep and high; stream shallow and swift; stream-bed rocky. January 19.

12. Finca Germania, near Comasagua, on mountain range, called La Cumbre, parallel to coast and about 10 miles inland. Alt. 3000 ft. Trails through coffee plantation, along streams and on hillsides. January 22.

13. Road between Finca Germania and Finca San Antonio, La Cumbre. Alt. 3000 ft. January 23.

14. Hacienda Cuyagualo, south of Lago Zapotitlan, along the river Gualo. Alt. 1000 ft. A wide, flat, dry valley, most of which was planted with corn and cotton. January 27.

15. La Libertad. West along dry stream-bed through Finca Santa Emilia and back along coast. Sea level. February 11.

III. Department of Sonsonate.

16. Road to Sonsonate and village of Nahulingo. Alt. 900 ft. February 21.

IV. Departments of San Vicente, Usulutan, and La Union.

17. Pan American highway to San Vicente. Alt. 2000 ft. February 14.

18. San Vicente to La Union. Alt. diminishing to sea level. Stops were made in the dry flats along the Lempa River, in Santiago de María, at Finca San Jaime and La Union. All of this part of the country was extremely dry, and not many species were found in bloom. February 15.

V. Department of Santa Ana.

19. Volcano of Santa Ana. Alt. 7800 ft. Trail passed through open areas with low shrubby growth, pine forest, and dark, damp cloud forest to open area at the top near the rim of the crater. February 19.

20. Hacienda San Miguel, above Métapán. Alt. 2600 ft. Trail to Cerro El Pinal, alt. 4600 ft., through oak and pine forest; along the San Miguel River. February 22.

21. Hacienda San José (alt. 5400 ft.) to Hacienda Los Planes (alt. 8300 ft.) Steep rough trail through oak and pine forests, mountains n.e. of Metapan. February 24.

22. Cerro Miramundo, above Hacienda Los Planes. Alt. 8000 ft. Trail leads first through a cleared area covered with shrubby growth. The cloud forest begins at 7300 ft. On the peak we came out of the forest into an area of low stiff shrubs. February 25.

23. Hacienda La Barra. Alt. 1400 ft. The north shore of Lago Güija, on a long point of land which extends out into the lake and lies on the Guatemalan boundary. Land flat, inundated during the rainy season; groves of enormous trees whose trunks stand 4–5 feet deep in water when land is inundated. February 27.

24. Metapán. Alt. 1400 ft. Streets and gardens in town. February 26.

VI. Department of Chalatenango.

25. Road between San Salvador and La Palma. Alt. 2300 ft. to 3000 ft. North of crossing of Lempa River, Semi-desert, flat. February 12.

26. Same as 25, but higher in the mountains and nearer the Honduran boundary. First stop in mixed forest—oak, liquidambar, pine. Second stop still higher in pure pine forest. February 12.

VII. Department of La Paz.

27. Hacienda Santa Thomas. Southeast from Sal Salvador, near coast. Alt. 150 ft. Through forest of flood plain to Pacific beach. February 6, 7.

VIII. Copan, Honduras.

28. Vicinity of the ruins of Copan. Alt. 2000 ft. Above a river valley. February 10.

The plants are listed below by families and the families are arranged as by Standley and Calderon (2). Most of the plants which are generally dis-

tributed in tropical regions are omitted. One new species (*Salvia Carlsonae* Standl. & Steyerm.) is listed, but this plant has not yet been described.

Typhaceae

TYPHA TRUXILLENSIS HBK. *265*. Sonsonate, alt. 900′. Feb. 21.

Gramineae

ARTHROSTYLIDIUM RACEMIFLORUM Steud. *1006*. Cerro Miramundo, alt. 8700′. Feb. 25.

Cyperaceae

CAREX DONNELL-SMITHII L. H. Bailey. *911*. Cerro Miramundo, alt. 8700′. Feb. 25.

Araceae

ANTHURIUM SUBCORDATUM Schott. *940*. Cerro Miramundo, alt. 8700′. Feb. 25.

Lemnaceae

LEMNA MINOR L. *1045*. Metapán, alt. 1400′. Feb. 26.

Bromeliaceae

TILLANDSIA LEIBOLDIANA Schlecht. *732*. Volcano San Salvador. Jan. 30.

Commelinaceae

COMMELINA ERECTA L., *47*. San Salvador, alt. 2300′. Jan. 13; *654*. San Vicente, alt. 2000′. Feb. 14.

Liliaceae

SMILAX JALAPENSIS Schlecht. *719*. Volcano Santa Ana, alt. 7800′. Feb. 19.
SMILACINA FLEXUOSA Bertol. *717*. Volcano Santa Ana, alt. 7800′. Feb. 19.
SMILACINA PANICULATA Mart. & Gal. *713*. Volcano Santa Ana, alt. 7800′. Feb. 19; 901. Cerro Miramundo, alt. 8700′. Feb. 25.

Musaceae

HELICONIA COLLINSIANA Griggs. *162*. Rio Colón, alt. 2500′. Jan. 19.

Piperaceae

PEPEROMIA COLLOCATA Trelease. *483*. Volcano San Salvador, alt. 6700′. Feb. 3; *976*. Cerro Miramundo, alt. 8700′. Feb. 25.
PEPEROMIA GALLIOIDES HBK. *233*.Finca San Antonio, alt. 3000′. Jan. 23; 474. Volcano San Salvador, alt. 6300′. Jan. 31; *718*. Volcano Santa Ana, alt. 7800′. Feb. 19.
PEPEROMIA OBTUSIFOLIA (L.) A. Dietr. *484*. Volcano San Salvador, alt. 6700′. Feb. 3; *915*. Cerro Miramundo, alt. 8700′. Feb. 25.
PEPEROMIA QUADRIFOLIA (L.) HBK. *113*. Finca Paraiso, alt. 3200′. Jan. 14; *266*. Finca Germania, alt. 3000′. Jan. 22; *889, 938*. Cerro Miramundo, alt. 8700′. Feb. 25.
PEPEROMIA REFLEXA (L.f.) A. Dietr. *937*. Cerro Miramundo, alt. 8700′. Feb. 25.
PIPER AMALAGO L. *320*. Cerro Chulo, alt. 4000′. Jan. 28.
PIPER SUBCITRIFOLIUM C. DC. *139*. Finca Los Naranjos, alt. 3900′. Jan. 16.

Myricaceae

MYRICA CERIFERA L. *591*. Pa Palma, alt. 5000′. Feb. 12; *736*. Volcano Santa Ana, alt. 7800′. Feb. 19; *756*. Hacienda San Miguel, alt. 2600′. Feb. 22; *960*. Cerro Miramundo, alt. 8700′. Feb. 25.

Betulaceae

ALNUS ARGUTA (Schlecht.) Spach. *710*. Volcano Santa Ana, alt. 7800′. Jan. 30.

Moraceae

BROSIMUM ALICASTRUM L. *518*. Copán, Honduras, alt. 2000′. Feb. 10.
CECROPIA OBTUSIFOLIA Bertol. *179*, Colón, alt. 2500′. Jan. 19.
FICUS COTINIFOLIA HBK. *954*. Cerro Miramundo, alt. 8700′. Feb. 25.
FICUS INAMOENA Standl. *526*. Copán, Honduras, alt. 2000′. Feb. 10.

Proteaceae

ROUPALA BOREALIS Hemsl. *462*. Volcano San Salvador, alt. 6700′. Feb. 3.

Loranthaceae

PHORADENDRON CRISPUM Trelease. *881*. Cerro Miramundo, alt. 8700′. Feb. 25.
STRUTHANTHUS DENSIFLORUS (Benth.) Standl. *213*. Finca Germania, alt. 3000′. Jan. 22.

Polygonaceae

POLYGONUM MEXICANUM Small. *1019*. La Barra, alt. 1400′. Feb. 27.
TRIPLARIS MELAENODENDRON (Bertol.) Standl. & Steyerm. *560*. San Salvador, alt. 2300′. Feb. 8.

Basellaceae

BOUSSINGAULTIA RAMOSA (Moq.) Hemsl. *188*. Sonsonate, alt. 900′. Feb. 21.

Caryophyllaceae

STELLARIA CUSPIDATA Willd. *695*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Menispermaceae

TRIPODANDRA CUMANENSIS (Kunth) Woodson. *50*. San Salvador, alt. 2300′. Jan. 13.

Annonaceae

CANANGA ODORATA (Lam.) Hook. & Thoms. *285, 1150*. Finca Paraiso, alt. 3200′. Feb. 14.

Lauraceae

PHOEBE MEXICANA Meissn. *408*. Volcano San Salvador, alt. 6300′. Jan. 31.

Hamamelidaceae

LIQUIDAMBAR STYRACIFLUA L. *608*. La Palma, alt. 5000′. Feb. 12; *757*, Hacienda San Miguel, alt. 2600′. Feb. 22.

Rosaceae

RUBUS ADENOTRICHOS Schlecht. *381*. Finca Florencia, alt. 6200′. Jan. 30.
RUBUS MACROGONGYLUS Focke. *697*. Volcano Santa Ana, alt. 7800′. Feb. 19.
RUBUS ROSAEFOLIUS J. E. Smith. *499*. Finca Florencia, alt. 6300′. Jan. 30.

Leguminosae

ACACIA SPADICIGERA Schl. & Cham. *55*. San Salvador, alt. 2300′. Jan. 13; *293*. Cuyagualo, alt. 1000′. Jan. 27.
CAESALPINIA CONZATTII (Rose) Standl. *561*. La Libertad, sea level. Feb. 11.
CAJANUS DISCOLOR DC. *19*. San Marcos, alt. 2600′. Jan. 10.
CASSIA INDECORA HBK. *217*. Finca Germania, alt. 3000′. Jan. 22.
CASSIA GUATEMALENSIS Donn. Smith. *949a*. Cerro Miramundo, alt. 8700′. Feb. 25.
CROTALARIA MUCRONATA Desv. *69*. Finca, Paraiso, alt. 3200′. Jan. 14.
DALBERGIA GLABRA (Mill.) Standl. *564*. La Libertad, alt. sea level. Feb. 11.
DALEA VULNERARIA Oerst. *788*. Hacienda San Miguel, alt. 2600′. Feb. 22.
DIPHYSA FLORIBUNDA Peyr. *439*. Crater, Volcano San Salvador, alt. 4700′. Feb. 2; *949*. Cerro Miramundo, alt. 8700′. Feb. 25.
DESMODIUM NICARAGUENSE Benth. *267*. Finca Germania, alt. 3000′. Jan. 22.
DESMODIUM SCORPIURUS (Sw.) Desv. *301*. Hacienda Cuyagualo, alt. 1000′ Jan. 27.
ERYTHRINA BERTEROANA Urban. *93*. Finca Paraiso, alt. 3200′. Jan. 14.
ERYTHRINA MACROPHYLLA DC. *420*. Volcano San Salvador, alt. 6300′. Jan. 31.
GLIRICIDIA GUATEMALENSIS Micheli. *758*. Hacienda San Miguel, alt. 2600′. Feb. 22.
INGA MICHELIANA Harms. *206*. Finca Germania, alt. 3000′. Jan. 22.

Geraniaceae

GERANIUM GUATEMALENSE Knuth. *358*. Finca Florencia, alt. 6200′. Feb. 2; *696*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Euphorbiaceae

CNIDOSCOLUS ACONITIFOLIUS (Mill.) I. M. Johnston. *535*. Copán, Honduras, alt. 2000′. Feb. 10.
CNIDOSCOLUS TUBULOSUS (M. Arg.) I. M. Johnston. *782*. San Miguel, alt. 2600′. Feb. 22.
CROTON GUATEMALENSIS Lotsy. *205*. Finca Germania, alt. 3000′. Jan. 22.
EUPHORBIA SCABRELLA Boiss. *214*. Finca San Antonio, alt. 3000′. Jan. 23; *699*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Aquifoliaceae

ILEX TOLUCANA Hemsl. *463*. Volcano San Salvador, alt. 6300′. Feb. 3.

Celastraceae

CELASTRUS VULCANICOLA Donn. Smith. *900*. Cerro Miramundo, alt. 8700′. Feb. 27.
ZINOWIEWIA RUBRA Lundell. *689*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Rhamnaceae

RHAMNUS CAPREAEFOLIA Benth. *476*. Volcano San Salvador, alt. 6300′. Feb. 3.

Vitaceae

CISSUS MARTINIANA Woodson & Seibert. *918*. Cerro Miramundo, alt. 8700′. Feb. 25.

Tiliaceae

TRIUMFETTA DUMETORUM Schlecht. *723*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Sterculiaceae

HELICTERES MEXICANA HBK. *857*. Hacienda San José, alt. 5400′. Feb. 24.

Dilleniaceae

SAURAUIA KEGELIANA Schlecht. *73*. Finca Paraiso, alt. 3200′. Jan. 14; *222*. Finca San Antonio, alt. 3000′. Jan. 23; *436*. Crater, Volcano San Salvador, alt. 4700′. Feb. 2.
SAURAUIA SUBALPINA Donn. Smith. *755*. San. Miguel, alt. 2600′. Feb. 22.

Guttiferae

CLUSIA GUATEMALENSIS Hemsl. *105, 108*. Finca Paraiso, alt. 3200′. Jan. 14; *239*. Finca San Antonio, alt. 3000′. Jan. 23; *786*. Hacienda San Miguel. alt. 2600′. Feb. 22.

Flacourtiaceae

CASEARIA LAEVIS Standl. *565*. La Libertad, alt. sea level. Feb. 11.
OLMEDIELLA BETSCHLERIANA (Goepp.) Loes. *905*. Cerro Miramundo, alt. 8700′. Feb. 25.
XYLOSMA FLEXUOSUM (HBK) Hemsl. *253*. Finca San Antonio, alt. 3000′. Jan. 23; *770*. San Miguel, alt. 2600′. Feb. 22.

Passifloraceae

PASSIFLORA MEMBRANACEA Benth. *685*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Begoniaceae

BEGONIA BARBANA C. DC. *392*. Volcano San Salvador, alt. 5000′. Jan. 31; *893*. Cerro Miramundo, alt. 8700′. Feb. 25.
BEGONIA CALDERONII Standl. *913*. Cerro Miramundo, alt. 8700′. Feb. 25.

Thymelaeaceae

DAPHNOPSIS MALACOPHYLLA Standl. & Steyerm. *919*. Cerro Miramundo, alt. 8700′. Feb. 25.

Myrtaceae

CALYPTRANTHES PENDULA Berg. *920*. Cerro Miramundo, alt. 8700′. Feb. 25.
MYRTUS MONTANA Benth. *883, 884*. Cerro Miramundo, alt. 8700′. Feb. 25.

Melastomaceae

CENTRADENIA BERNOULLII Cario. *1*. San Marcos, alt. 2600′. Jan. 10.
HETEROCENTRON GLANDULOSUM Schenck. *15*. San Marcos, alt. 2600′. Jan. 10.
HETEROTRICHUM GLANDULOSUM Schenck. *377*. Finca Florencia, alt. 6200′. Jan. 30.
MICONIA GLABERRIMA (Schlecht.) Naud. *914*. Cerro Miramundo, alt. 8700′. Feb. 25.
MICONIA GUATEMALENSIS Cogn. *693*. Volcano Santa Ana, alt. 7800′. Feb. 19.
MICONIA LAURIFORMIS Naud. *943*. Cerro Miramundo, alt. 8700′. Feb. 25.

MICONIA PTEROPODA Benth. *577.* La Palma, alt. 5000′. Feb. 12.
MONOCHAETUM DEPPEANUM (S. & C.) Naud. *701.* Volcano Santa Ana, alt. 7800′. Feb. 19.

Onagraceae

FUCHSIA ARBORESCENS Sims. *698.* Volcano Santa Ana, alt. 7800′. Feb. 19; *987.* Cerro Miramundo, alt. 8700′. Feb. 25.
FUCHSIA MICHOACANENSIS. Sesse & Moc. *326.* Cerro Chulo, alt. 4000′. Jan. 28; *498.* Finca Florencia, alt. 6200′. Jan. 30.
LOPEZIA MEXICANA Juss. *371*, *381a.* Finca Florencia, alt. 6200′. Jan. 30.
OENOTHERA SIMSIANA Seringe. *721.* Volcano Santa Ana, alt. 7800′. Feb. 19.

Umbelliferae

APIUM LEPTOPHYLLUM (DC.) F. Muell. *252.* Finca San Antonio, alt. 3000′. Jan. 22; *397.* Volcano San Salvador, alt. 6300′. Jan. 31.
SANICULA LIBERTA Schl. & Cham. *888.* Cerro Miramundo, alt. 8700′. Feb. 25.

Clethraceae

CLETHRA PACHECOANA Standl. & Steyerm. *709.* Volcano Santa Ana, alt. 7800′. Feb. 19.
CLETHRA SALVADORENSIS Britton. *447.* Crater, Volcano San Salvador, alt. 4700′. Feb. 2.

Pyrolaceae

CHIMAPHILA UMBELLATA var. MEXICANA DC. *602.* La Palma, alt. 5000′. Feb. 12.

Ericaceae

CAVENDISHIA GUATEMALENSIS Loes. *910*, *978.* Cerro Miramundo, alt. 8700′. Feb. 25.
GAULTHERIA CHIAPENSIS Camp. *880.* Cerro Miramundo, alt. 8700′. Feb. 25.
GAULTHERIA LANCIFOLIA VAR. DULCIS Camp. *700.* Volcano Santa Ana, alt. 7800′. Feb. 19.
VACCINIUM POASANUM Donn. Smith. *916*, *944.* Cerro Miramundo, alt. 8700′. Feb. 25.
LEUCOTHOEINA MEXICANA (Hemsl.) Small. *956.* Cerro Miramundo, alt. 8700′. Feb. 25.

Myrsinaceae

ARDISIA BREVIFOLIA Standl. & Steyerm. *877.* Cerro Miramundo, alt. 8700′. Feb. 25.

Styracaceae

STYRAX POLYNEURUS Perk. *690.* Volcano Santa Ana, alt. 7800′. Feb. 19.

Loganiaceae

BUDDLEIA NITIDA Benth. *458.* Volcano San Salvador, alt. 6700′. Feb. 3.

Apocynaceae

STEMMADENIA DONNELL-SMITHII (Rose) Woodson. *646*, *649.* San Vicente, alt. 2000′. Feb. 14.

Asclepiadaceae

SARCOSTEMMA CLUSUM (Jacq.) Schltr. *1013*. Hacienda La Barra, alt. 1400′. Feb. 27.

Convolvulaceae

IPOMOEA SANTAE-ROSAE Standl. & Steyerm. *95*. Finca Paraiso, alt. 3200′. Jan. 14; *194*. Finca Germania, alt. 3000′. Jan. 22.

Boraginaceae

BOURRERIA HUANITA (L. & L.) Hemsl. *234*. Finca San Antonio, alt. 3000′. Jan. 23.

CORDIA DENTATA Poir. *290*. Cuyagualo, alt. 1000′. Jan. 27; *555*. La Libertad, sea level. Feb. 11.

HELIOTROPIUM OAXACANUM DC. *743*. Hacienda San Miguel, alt. 2600′. Feb. 22.

HELIOTROPIUM RUFIPILUM (Benth.) I. M. Johnston. *71*. Finca Paraiso, alt. 3200′. Jan. 14; *827*. Hacienda San Miguel, alt. 2000′. Feb. 23.

Verbenaceae

LANTANA HISPIDA HBK. *989*. Cerro Miramundo, alt. 8700′. Feb. 25.

LIPPIA SUBSTRIGOSA TURCZ. *380*. Finca Florencia, alt. 6200′. Jan. 30.

STACHYTARPHETA FRANTZII Polak. *354*. Cerro Chulo, alt. 4000′. Jan. 28.

Labiatae

Salvia Carlsonae Standl. & Steyerm. sp. nov. ined. *453*. Volcano San Salvador, alt. 5500′. Feb. 3; *986*. Cerro Miramundo, alt. 8700′. Feb. 25.

SALVIA KARWINSKII Benth. *858* Hacienda San José, alt. 5400′: Feb. 24; *991*. Cerro Miramundo, alt. 8700′. Feb. 25.

SALVIA SHANNONI Donn. Smith. *587*. La Palma, alt. 5000′. Feb. 12, *808*. Hacienda San Miguel, alt. 2600′. Feb. 22.

Solanaceae

CESTRUM GUATEMALENSE Francey. *712*. Volcano Santa Ana, alt. 7800′. Feb. 19.

LYCIANTHES ARRAZOLENSIS (Coult. & D. Sm.) Bitter. *681*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Scrophulariaceae

CASTILLEJA INTEGRIFOLIA L. f. *992*. Cerro Miramundo, alt. 8700′. Feb. 25.

Lentibulariaceae

PINGUICULA MORANENSIS HBK. *885*. Cerro Miramundo, alt. 8700′. Feb. 25.

Acanthaceae

APHELANDRA GIGANTIFLORA Lindau. *89*. Finca Paraiso, alt. 3200′. Jan. 14.

ODONTONEMA TUBIFLORUM (Bertol.) Kuntze. *83*. Finca Paraiso, alt. 3200′. Jan. 14.

Rubiaceae

CEPHAELIS AXILLARIS Schwartz. *896*. Cerro Miramundo, alt. 8700′. Feb. 25.

RONDELETIA LANIFLORA Benth. *683, 708*. Volcano Santa Ana, alt. 7800′. Feb. 19.

Caprifoliaceae

VIBURNUM GUATEMALENSE Gandoger. *389*, *459*. Finca Florencia, Volcano San Salvador, alt. 5000′. Jan. 30.

Compositae

BIDENS PILOSA VAR. MUCRONATA F. ODORATA (Cav.) Sherff. *687*. Volcano Santa Ana, alt. 7800′. Feb. 19.

CIRSIUM SUBCORIACEUM (Less.) Sch. Bip. *705*. Volcano Santa Ana, alt. 7800′. Feb. 19.

CONYZA APURENSIS HBK. *302*. Cuyagualo, alt. 1000′. Jan. 27.

ELEPHANTOPUS MOLLIS HBK. *12*. San Marcos, alt. 2600′. Jan. 10.

EUPATORIUM ARALIAEFOLIUM Less. *917*. Cerro Miramundo, alt. 8700′. Feb. 25.

EUPATORIUM COULTERI Robinson. *175*. Volcano San Salvador, alt. 6700′. Feb. 3.

EUPATORIUM LIGUSTRINUM DC. *604*. La Palma, alt. 4000′. Feb. 12.

EUPATORIUM LUXII Robinson. *715*. Volcano Santa Ana, alt. 7800′. Feb. 19.

EUPATORIUM MAIRETIANUM DC. *950*. Cerro Miramundo, alt. 8700′. Feb. 25.

EUPATORIUM MICROSTEMON Steetz. *854*. Los Planes, alt. 3500′. Jan. 10.

EUPATORIUM SKUTCHII Robinson. *385*. Finca Florencia, alt. 5000′. Jan. 30.

GNAPHALIUM AMERICANUM Mill. *351*. Cerro Chulo, alt. 4000′. Jan. 28.

LIABUM SUBLOBATUM Robinson. *171*. Finca Santa María, alt. 2500′. Jan. 19. *387*. Finca Florencia, alt. 5000′. Jan. 30; *442*. Crater, Volcano San Salvador, alt. 4700′. Feb. 2.

MELAMPODIUM OBLONGIFOLIUM DC. *106*. Finca Paraiso, alt. 3200′. Jan. 14; *405*. Volcano San Salvador, alt. 6300′. Jan. 31; *873*. Cerro Miramundo, alt. 8700′. Feb. 25.

MELANTHERA NIVEA (L.) Small. *13*. San Marcos, alt. 2600′. Jan. 10; *468*. Volcano San Salvador, alt. 6300′. Jan. 31.

PEREZIA NUDICAULIS Gray. *596*. La Palma, alt. 4000′. Feb. 12; *759*. San Miguel, alt. 2600′. Feb. 22.

SENECIO ARBORESCENS Steetz. *711*. Volcano Santa Ana, alt. 7800′. Feb. 19.

SENECIO CHINOTEGENSIS Klatt. *27*. Los Planes, alt. 3500′. Jan. 11.

SENECIO PETASIOIDES Greenm. *379*. Finca Florencia, alt. 5000′. Jan. 30; *947*. Cerro Miramundo, alt. 8700′. Feb. 25.

SENECIO SERRAQUITCHENSIS Greenm. *465*. Volcano San Salvador, alt. 6700′. Feb. 3; *780*. Hacienda San Miguel, alt. 2600′. Feb. 22; *988*. Cerro Miramundo, alt. 8700′, Feb. 25.

SENECIO THOMASII Klatt. *742*. Hacienda San Miguel, alt. 2600′. Feb. 22; *959*. Cerro Miramundo, alt. 8700′. Feb. 25.

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Literature Cited

1. **Kovar, Anton.** Idea general de la vegetación de El Salvador. *In:* Frans Verdoorn (ed.), Plants and plant science in Latin America 56, 57. The Chronica Botanica Company, 1945.
2. **Standley, Paul C. & Calderon, Salvador.** Lista preliminar de las plantas de El Salvador. San Salvador, 1926.
3. **Tucker, J. M. & Muller, C. H.** Additions to the oak flora of El Salvador. Madroño 7: 111–117. 1945.

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ON RAFINESQUE'S NAMES FOR THE CHARACEAE

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Rafinesque's very sketchy contributions to the literature on the Characeae extended from 1808 to 1836, and appear to be limited to one order, four genera, and eight species. All of these, except for the one Linnean genus *Chara*, have been entirely overlooked by specialists; and it remained for Merrill (1943) to bring these works to the attention of the botanical world.

A study of the original descriptions, in light of the existing knowledge of the Characeae of the United States, has enabled the writer to reconstruct what possibly seems to be a plausible interpretation of Rafinesque's original meanings. The statement that "This G[enus] (Leiacina) with Chara and Acinaria Raf. 1819, form [the] natural order Characea, near the Confervas" (Raf. 1825, p. 4) affords the clue that Rafinesque recognized three separate genera, and that he considered them an unique order of the algae. Though what synonymy exists is confused, in reconstructing the picture, the bulk of meager evidence would suggest that he recognized what we now distinguish as the genera *Chara*, *Nitella*, and *Tolypella*. Despite this conclusion, a strict interpretation of the available data requires allocation of his genera to only *Nitella* and *Chara*.

The writer is indebted to E. D. Merrill for bringing these facts to his attention, and for making the excellent collection of these old works available for study.

CHARACEAE Richard apud Humboldt & Bonpland

CHARACEAE Richard ap. Humboldt & Bonpland, Nov. Gen. Spec. Plant. **1**: 38. 1815. *Characea* Raf. Neogenyton 4. 1825, nom. nov.

"This G[enus] (Leiacina) with Chara and Acinaria Raf. 1819, form [the] natural order Characea, near Confervas."

Rafinesque's usage strongly indicates that his order corresponds to the modern concept of family. Accordingly, the present writer has cited the family Characeae as the synonym of Characea Raf. instead of the order Charales.

CHARA Vaill. ex Linn.

CHARA Vaill. ex L. Gen. Plant. ed. 5. 491. 1754; Raf. Med. Repos. II, **5**: 354. 1808, nom.; Merrill, Farlowia **1**: 252. 1943. *Characias* Raf. Anal. Nat. Tab. Univ. 209. 1815, nom.; Raf. Fl. Telluriana **1**: 56. 1836, nom. (= *Chara* L.); Merrill, Farlowia **1**: 252. 1943 (= *Chara* L.).

CHARA CONTRARIA Kützing, Phyc. Germ. 258. 1845. ? *C. fetidissima* Raf. [nom. nud.] Med. Repos. II, **5**: 354. 1808, nom.; Raf. Jour. Bot. (Paris) **2**: 174. 1809, nom. (for Eastern United States); Merrill, Farlowia **1**: 252. 1943.

CHARA sp. ? *Chara patens* Raf. [nom. nud.] Med. Repos. II, **5**: 354. 1808, nom.; Raf. Jour. Bot. (Paris) **2**: 174. 1809, nom.; Merrill, Farlowia **1**: 252. 1943.

NITELLA Ag. emend. Braun

NITELLA Ag. Syst. Alg. xxvii. 1824; emend. Braun, Hooker's Jour. Bot. **1**: 195, 292. 1849. ? *Leiacina* Raf. [nom. inq.] Neogenyton 4. 1825, descr.; Merrill, Farlowia **1**: 253. 1943. [= *Nitella*, pro synon. per *N. capitellata* Braun (= *C. capitata* Elliott = *L. capitata* (Ell.) Raf.)] (= *Tolypella*, pro descr.). ? *Acinaria* Raf. [nom. inq.] Jour. Phys. Chim. Hist. Nat. **89**: 107. 1819, descr.; iter. Isis von Oken 1820, **1**: Lit. Anz. 243. 1820, descr.; Raf. Neogenyton 4. 1825, nom. = *Chara* Linn. [pro parte]; Merrill, Farlowia **1**: 251. 1943.

"65. Leiacina. Diff. *Chara;* fruit berry-like, smooth, monolocular, polysperm, with four persistent scales at the base; top naked. *Stems terete, articulate; leaves acute in whorls; fruits axillary, capitate*" (Raf. 1820).

Based on *L. capitata* Raf. (below), this genus must be officially considered synonymous with *Nitella* Ag., pro synon. The genus description, on the other hand, suggests *Tolypella*, particularly in being capitate, a condition which is particularly characteristic of this genus.

"48. *Acinaria.* (Algue fluviatile.) Thallus creux et articulé, polytome; lanières étroites à nervures longitudinales, planes. Fructification hypophylle en dessous des lanières, en grains moux, arrondis, rouges: cocciformes, disposés longitudinalement sur 2 ou 3 rangs.—Famille des Fucidées. Est-ce bien un genre d'Algue ? Il y en a plusieurs espèces dans l'Ohio, le Mississipi, le Missouri, l'Arkanzas, etc." (Raf. 1820).

The description, though imperfect, fits *Nitella* in many particulars. The round, red fruits enveloped in mucus leaves little doubt of the accuracy of this determination.

NITELLA CAPITELLATA Braun, Abh. Akad. Wiss. Berlin **1882**: 56. 1883. ? *Leiacina capitata* Raf. [nom. ambig.] Neogenyton 4. 1825; Merrill, l. c. (Non) *Chara capillaris* Kroeker, Florae Silesiacae **3**: 62. 1814. (Non) *C. capitata* Nees v. Esenbeck, Denkschr. Beierisch. Bot. Ges. **2**: 80. 1818. *C. capitata* Elliott, Bot. S. C. & G. **2**: 516. 1824.

"2. *L. capitata*, (*Chara* do. E.)[1] leaves terete by six, fruits pedicellate."

This description does not apply to *C. capitata* Elliott, since the fruiting heads are not pedicellate in that species. It is felt that Rafinesque apparently misidentified what material he had in hand, and that the plant was more likely a *Tolypella*.

NITELLA sp. ? *L. lucida* Raf. [nom. inq.] Neogenyton 4. 1825; Merrill, l. c.

"*L. lucida*, leaves filiform by seven to nine, fruits subsessile."

The writer finds this description inadequate to attempt a determination.

NITELLA ACUMINATA Wallm. Sv. Vets.-Akad. Handl. **1852**: 263. 1854. ? *A. flexuosa* Raf. [nom. inq.] Jour. Phys. Chim. Hist. Nat. **89**: 107. 1819. descr.; Raf. Isis von Oken 1820, **1**: Lit. Anz. 243. 1820; Raf. Neogenyton 4. 1825; Merrill, Farlowia **1**: 251. 1943.

"1. *A. flexuosa*. Lanières linéaires, aiguës, flexueuses, ondulées, éparses" (Raf. 1820).

The description is inadequate from which to determine the species of *Nitella*, though the pointed leaves suggest one of the *N. acuminata* group

[1] "*Chara do E.*" = *Chara capitata* Elliott.

which has acuminate leaves in contrast to the blunt leaves of the following species.

NITELLA FLEXILIS (L. pro parte) Ag. Syst. Alg. 124. 1824. ? *A. coccifera* Raf. [nom. inq.] Jour. Phys. Chim. Hist. Nat. **89**: 107. 1819; Raf. Isis von Oken 1820 **1**: Lit. Anz. 243. 1820; Raf. Neogenyton 4. 1825; Merrill, Farlowia **1**: 251. 1943.

"2. *A. coccifera*. Lanières linéaires, lanceolées, éparses, obtuses, planes" (Raf. 1820).

The description is inadequate for determination, but the obtuse leaves suggest the common *Nitella flexilis*, or one of the species which has rather blunt apices in contrast to the acuminate ones in the *N. acuminata* series.

NITELLA sp. ? *A. latifolia* Raf. [nom. inq.] Jour. Phys. Chim. Hist. Nat. **89**: 107. 1819, descr.; Raf. Isis von Oken 1820 **1**: Lit. Anz. 243. 1820; Raf. Neogenyton 4. 1825; Merrill, Farlowia **1**: 251. 1943.

"3. *A. latifolia*. Feuilles lanceolées, presque opposées! ou plantes dichotome, lanières terminales, étroites; grains conglobés, brun-rougeatres" (Raf. 1820).

This very confusing description is certainly unlike a Charophyte, which, despite the fact that certain dried material might be so arranged as to appear dichotomous, hardly could show the other features listed. How a *Nitella* leaf could be construed to be lanceolate is a question, except perhaps in certain forms of *N. clavata* with inflated leaflets. The description of aggregated, reddish-brown fruits could fit a *Nitella* as well as certain other aquatic plants.

NITELLA PRAELONGA Braun, Abh. Akad. Wiss. Berlin **1882**: 40. 1883. ? *A. salicifolia* Raf. [nom. inq.] Jour. Phys. Chim. Hist. Nat. **89**: 107. 1819, descr.; Raf. Isis von Oken 1820 **1**: Lit. Anz. 243. 1820; Raf. Neogenyton 4. 1825; Merrill, Farlowia **1**: 251. 1943.

"4. *A. salicifolia*. Lanières linéaires, aiguës, planes, grains terminaux spiciformes. Dans Red-River [Louisiana or Texas ?]" (Raf. 1820).

This description is as confusing as that for the preceding species. The statement that fruits are in terminal spikes would suggest *Nitella Morongii* Allen or *N. praelonga* Braun. The distribution eliminates the first which so far as is known is restricted to northeastern North America, and strongly substantiates the latter which is well represented throughout the south central states, particularly Texas. Furthermore, *N. praelonga* has fertile whorls contracted into somewhat spike-like "heads" borne terminally.

DISCUSSION

The significance of Rafinesque's works becomes highly critical in terms of the homonym rule. Were his classification to be recognized, *Characias* Raf. (1815) would be a synonym of *Chara* Vaill. ex Linn. (1754), and *Leiacina* Raf. (1825) of *Nitella* Ag. (1824) emend. Braun (1849); but *Leiacina* Raf., if reinterpreted, would take priority over *Tolypella* Braun (1849) emend. Leonhardi (1863), and *Acinaria* Raf. (1819) over *Nitella* Ag. (1824). Furthermore, his various species might be construed to take priority over later-described species. Perhaps fortunately, no specimens remain of Rafinesque's Characeae upon which one might establish his names.

Since the treatment by Rafinesque is so vague as to leave modern stu-

dents to conjecture upon possible identities; since no specimens remain upon which to establish names; since no figures of the Characeae remain; since the only genera substantiated by synonymy with earlier genera names or specimens, i.e., *Characias* and *Leiacina*, are both later homonyms; since the descriptions are insufficient and too confusing to make determination possible; the writer concludes that the entire series of species and the questionable genera must be disposed of as nomina inquirenda, and be assigned in synonymy to the categories to which they appear to approach.

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Literature Cited

Agardh, C. A. 1824. Systema Algarum, I. Lund.

Braun, A. 1849. Characeae australis et antarcticae. Hooker's Jour. Bot. & Kew Gard. Misc. **1**: 192–203.

————. 1849. Characeae Indiae Orientalis et insularum Maris Pacificis. Hooker's Jour. Bot. & Kew Gard. Misc. **1**: 292–301.

1883. Fragmente einer Monographie der Characeen. Nach der hinterlassenen Manuscripten A. Braun's herausgegeben von Dr. O. Nordstedt. Abh. Akad. Wiss. Berlin **1882**: 1–211.

Elliott, S. 1824. Sketch of the Botany of South Carolina and Georgia II. Charleston.

Krocker, A. J. 1814. Florae Silesiacae, vol. III. [Other volumes were entitled Flora Silesiaca.] Breslau.

Kützing, F. T. 1845. Phycologia Germanica. Nordhausen.

Leonhardi, H. von. 1863. Die böhmischen Characeen. Lotos **13**: 55–80, 110–111.

Linnaeus, C. 1754. Genera Plantarum, ed. 5. Stockholm.

Merrill, E. D. 1943. An index to Rafinesque's published technical names for the cellular cryptogams. Farlowia **1**: 245–262.

————. Index Rafinesquianus. [in preparation.]

Nees von Esenbeck, C. G. 1818. *Chara capitata*, eine neue Art von Armleuchter nebst Bemerkungen über die Fruchttheile der Gattung. Denkschr. Beierisch. Bot. Ges. **2**: 64–83.

Rafinesque, C. S. 1808. Prospectus of Mr. Rafinesque Schmaltz's two intended works on North American botany; the first on the new genera and species of plants discovered by himself, and the second on the natural history of the funguses, or mushroom tribe of America. Medical Repository II. **5**: 350–356.

————. 1809. Journal de Botanique (société de botanistes; Paris) **2**: 174.

————. 1815. Analyse de la nature; ou, Tableau de l'univers et des corps organisés. Palerme. 224 pp.

————. 1819. Prodrome des nouveaux Genres des plantes observées en 1817 et 1818 dans l'interieur des Étas Unis d'Amerique. Jour. Phys. Chim. Hist. Nat. **89**: 107.

————. 1820. ibid. Isis von Oken 1820 **1**: Lit. Anz. p. 243.

————. 1825. Neogenyton, or indication of sixty-six new genera of plants of North America, p. 4. Lexington?, Ky.

–. 1836. Flora Telluriana, Part I. Lexington, Ky.

Richard, L. C. M. 1815. *In*: Bonpland and Humboldt, Nova Genera et Species Plantarum **1**: 38. Paris.

Wallman, J. 1854. Försök till en systematisck uppställning af växtfamiljen Characeae. Sv. Vets.-Akad. Handl. **1852**: 231–331.

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—III

BASSETT MAGUIRE AND COLLABORATORS

PIPERACEAE[40]

The Piperaceae is a large family with several hundred species distributed in the tropics and subtropics throughout the world. The largest number of species is to be found in the Americas where they range from the West Indies and Mexico through Central and South America to Argentina and Chile. The two principal genera are *Piper* and *Peperomia*.

PIPER L.

Mostly shrubs or small trees, occasionally scandent, or sometimes the plants are subherbaceous; leaves stipulate, always alternate, petiole frequently vaginate-winged; flowers small, in a dense, leaf-opposed spike, subtended by small, variously shaped glabrous or pubescent bracts; fruit small, drupe-like, with a thin pericarp; stigmas various but commonly 3. A very large genus with a great many tropical American species. Some of the Old World species are economically important, but the American species have little if any use.

PIPER ADENANDRUM (Miq.) C. DC. *Piper acarouanyanum* C. DC. in DC. Prodr. **16**[1]: 311. 1869. BRITISH GUIANA: frequent in dense second growth in windfall opening, heavy mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22870;* Verite Creek, Essequibo River, *F3626*. Also known from French Guiana.

PIPER ADUNCUM L. A shrub or small tree with sparsely pubescent twigs; leaves lanceolate to subelliptic, with pointed apex and rounded or cordulate base, about three times as long as wide, more or less pubescent and scabrous; spikes up to 15 cm. long, gradually curved; peduncle mostly longer than the petiole. SURINAM: coastal jungle, road to Carl Francois along Saramacca River, Km. 40 from Paramaribo, *27171;* frequent, Charlesburg Rift, 3 km. north of Paramaribo, *22784*. A very common and widespread species ranging from the West Indies to the mainland and nearly throughout the range of the genus in South America.

PIPER AEQUALE Vahl. A glabrous shrub with slender branches; leaves more or less elliptic or ovate, very variable in size, up to 15–17 cm. long, pinnately nerved to the upper third or nearly throughout, the nerves yellowish beneath, with attenuately blunt-acuminate apex and subequilaterally acute base, rather firm and somewhat glossy; spikes up to 10 cm. long. SURINAM: frequent on wet rocks in shaded places, base of cliffs, Augustus Falls, Tafelberg, *24769*. This collection is sterile but is believed to represent this species which is rather common and widely distributed from the West Indies throughout northern South America.

[40] T. G. Yuncker.

PIPER ARBOREUM Aubl. A glabrous shrub or small tree up to 7 m. tall, with more or less verrucose-warty internodes; leaves oblong-elliptic to subovate with acuminate apex and strongly inequilaterally rounded base with one side much shorter; petiole vaginate-winged to the blade; spikes slender and mostly 5–10 cm. long; fruit laterally flattened. BRITISH GUIANA: roadside, second growth, Mabaruma, Aruka River, Northwest District, *G5109*. SURINAM: east side, savanna, Zanderij I, *25056;* frequent, overhanging North Ridge Creek, Tafelberg, *24826;* infrequent, Charlesburg Rift, primary jungle, 3 km. north of Paramaribo, *22791*. A rather common species ranging through the West Indies and northeastern South America.

PIPER AUGUSTUM Rudge. A shrub or small tree to 5 or 8 m. tall, glabrous except for the more or less pubescent nerves beneath; leaves elliptic-ovate, 15–30 cm. or more long, acute at both ends, pinnately nerved throughout, glandular-dotted, spikes up to 15 mm. thick × 8–12 cm. long when mature. SURINAM: infrequent, south rocky slopes Arrowhead Basin, Tafelberg, *24609*. Rather widely distributed throughout northern South America.

PIPER CITRIFOLIUM Lam. A shrub up to 3 m. tall, glabrous except for the ciliate petiole keel and decurrent ridge; leaves lance- or oblong-elliptic, 8–16 cm. long, with acuminate apex and acute base, pinnately nerved throughout; spikes 3–4 cm. long. BRITISH GUIANA: frequent along trail, in heavy mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22861*. Distributed throughout the Guianas.

PIPER DEMERARANUM (Miq.) C. DC. A shrub 1–2 m. tall; twigs somewhat retrorsely crisp-pubescent; leaves elliptic, sublanceolate or oblanceolate, 15–20 cm. long, with acuminate apex and inequilaterally cordulate base, pinnately nerved throughout; petiole vaginate to the blade; spikes up to 4.5 cm. long; fruit depressed-globose, puberulent. BRITISH GUIANA: clearing, Mazaruni Station, Mazaruni River, *F3530*. Distributed through northeastern South America.

PIPER GLABRESCENS (Miq.) C. DC. var. **caparonum** (C. DC.) Yuncker, comb. nov. *Piper caparonum* C. DC. in Urb. Symb. Ant. **7**: 183. 1912. BRITISH GUIANA: secondary forest on lateritic gravelly soil, Mabaruma, Aruka River, Northwest District, *F5162;* secondary forest on clay soil, Mazaruni Station, Mazaruni River, *F3542*. Also known from Trinidad.

Piper Gleasonii Yuncker, sp. nov. Frutex, internodiis longis satis gracilibus, obscure et subretrorse hirsutis; folia elongato-elliptica, 20–27 cm. longa, 8–11 cm. lata, acute acuminata, basi inequilateraliter obtusa, latere uno quam altero 3–5 cm. breviore, pinnato-nervata, nervis quoque latere ca. 10 cum nervis minoribus intermediis, in sicco coriacea, nitida, revoluta, translucentia, supra glabra impresso-foveolata, subtus ad nervos hirsuta; petiolus 1–2 cm. longus, dense hirsutus, ad laminam vaginatus et anguste alatus; spicae 11 cm. longa 4 mm. in diametro; pedunculus 2 cm. longus, subretrorse hirtellus; bracteae triangulari-subpeltatae, margine dense fimbriatae; fructus depresso-obovoideus, velutinus, circum stigmata 3 sessilia convallatus.

A shrub; flowering internodes long and rather slender, dingy-subretrorsely-hirsute; leaves elongated-elliptic, 8–11 cm. wide × 20–27 cm. long, apex sharply acuminate, inequilaterally obtuse at the base with one side 3–5 mm. shorter at the petiole, pinnately nerved throughout, the nerves about 10 on each side, with intermediates, drying coriaceous, glossy, revolute,

translucent, glabrous and impressed-pitted above, staring-hirsute on the nerves beneath; petiole 1–2 cm. long, densely hirsute, vaginate and narrowly winged to the blade; spikes 4 mm. thick × 11 cm. long; peduncle 2 cm. long, subretrorsely hirtellous; bracts triangular-subpeltate, marginally densely fringed; fruit depressed-obovoid, velvety, convallate about the 3 sessile stigmas.

The densely hirsute stems and nerves beneath, and velvety-puberulent depressed-obovoid fruit are distinctive of this species.

TYPE: Rockstone, British Guiana, July 15–August 1, 1921, *H. A. Gleason 857*. New York Botanical Garden. SURINAM: vicinity of Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24112;* montane forest, line beyond Pakira Camp (4), Coppenam River Headwaters, *24170*.

PIPER HOSTMANNIANUM (Miq.) C. DC. A shrub, sometimes more or less scandent, generally crisply subsilky excepting the upper leaf surface; leaves more or less elliptic or subovate, 12–20 cm. or more long, apex acuminate, rather glossy, base oblique, inequilaterally obtuse or cordulate; nerves more or less impressed above; spikes 10–12 cm. long. BRITISH GUIANA: rope climbing to 10 m., high forest, Kamuni Creek, Groete Creek, Essequibo River, *22901*. Also known from Surinam and Venezuela.

Piper saramaccanum Yuncker, sp. nov. Frutex vel arbuscula 3 m. alta, internodiis superioribus satis gracilibus, brunneo-villosis; folia elliptico-subobovata, 30–33 cm. longa, 17–21 cm. lata, apice breviter abrupteque acuminata, basi oblique inaequilatera, ad petioli apicem abrupte acuta, latere breviore vix lobato, latere longiore cordato, lobo rotundato quam petiolo dimidio breviore, pinnatim nervatis, nervis utrinsecus ca. 7, cum nervis 2–3 brevioribus in lobum descendentibus, marginem versus paullo furcatis et arcuatim connectis, supra glabra praeter costam ad basin imam villosam, subtus tenuiter brunneo-pubescentia praecipue ad nervos, in sicco firmula coriacea; petiolus 6 cm. longus, dense brunneo-villosus, ad laminam vaginato-alatus; spica 28 cm. longa 3 mm. in diametro; pedunculus 4 cm. longus, pubescens; bracteae inflexo-subcucullatae, apice truncato subtriangulari fimbriato; ovarium subovoideum, a latera complanatum, cum rachide elongatum.

A shrub or small tree 3 m. tall; upper internodes rather slender, brown villous; leaves elliptic-subovate, 17–21 cm. wide × 30–33 cm. long, apex abruptly short-acuminate, base obliquely inequilateral, abruptly acute at the petiole, with the shorter side scarcely lobed, the longer side cordate with the lobe rounded and half as long as the petiole, pinnately nerved below the upper third, the nerves about 7 on each side with 2 or 3 shorter descending nerves in the lobe, the nerves somewhat branched upward and submarginally loop-connected, glabrous above except the midrib which is villous at the very base, thinly brown-pubescent beneath with the nerves more densely so, drying firm, coriaceous; petiole 6 cm. long, densely brown villous, vaginate-winged to the blade; spike 3 mm. thick × 28 cm. long; peduncle 4 cm. long, pubescent; bracts inflexed-subcucullate, the apex truncate subtriangular, marginally fringed; ovary subovoid, laterally flattened and elongated with the rachis.

TYPE: shrub or small tree to 3 m. high, spikes pendent, km. 3.5, vicinity Krappa Camp (2), Saramacca River Headwaters, Surinam, October 6, 1944, *Maguire 24887*. New York Botanical Garden. Known only from the type locality.

PIPER SUBMELANOSTICTUM C. DC. var. **amelanostictum** Yuncker, var. nov. Frutex 3 m. altus; folia 22–30 (35) cm. longa, 11–15 (20) cm. lata, non glanduloso-punctata; spicae 20–30 cm. longae.

A shrub 3 m. tall; leaves 11–15 (20) cm. wide × 22–30 (35) cm. long, not glandular dotted; spikes 20–30 cm. long. Otherwise as in the species.

TYPE: in dense upland forest, Rockstone, British Guiana, July 15–Aug. 1, 1921, *Gleason 566*, N. Y. Bot. Gard. SURINAM: frequent, in mixed high forest, base north escarpment, vicinity foot of Augustus Falls, Tafelberg, *24749*. The species from near Cayenne, French Guiana.

Piper Maguirei Yuncker, sp. nov. Frutex vix 0.5 m. altus; caulibus simplicibus, gracilibus, internodiis brevibus villosis; folia elliptica vel lanceolato-elliptica, 10–16 cm. longa, 4–6 cm. lata, apice obtusa, basi oblique subinequilateralia, latere vix breviore obtuso vel subacuto, latere longiore rotundato et obtuse vel paullo cordulato, pinnatim nervatis, nervis quoque latere ca. 10 marginem versus arcuatim connectis cum nervulis transversis anastomantibus, supra glabra, subtus ad nervis sparse crispato-pubescentia, glanduloso-punctata, in sicco membranacea, transluceentia; petiolus vix 5 mm. longus, villosus, basin versus vaginatus; apica 2 cm. longa, 2 mm. in diametro; pedunculus gracilis, 10 mm. longus, glaber; bracteae inflexo-cucullatae, glabrae vel paullo ciliatae, glanduloso-punctatae; ovarium ovoideum, rubro-glanduloso-punctatum, apice angustatum in stylum crassum brevissimum, aut stylus fere nullus; stigmata 3, recurvata.

A simple slender-stemmed shrub, scarcely 0.5 m. tall; internodes short and slender, villous; leaves elliptic or lance-elliptic, 4–6 cm. wide × 10–16 cm. long, apex obtuse, base obliquely subinequilateral with the shorter side obtuse or acutish, the longer side rounded and obtuse or slightly cordulate, pinnately nerved throughout, the nerves about 10 on each side, submarginally loop-connected and with slender cross-connecting and anastamosing nervules, glabrous above, the nerves beneath sparsely crisp-pubescent, glandular-dotted, drying membranous, translucent; petiole scant 5 mm. long, villous, vaginate toward the base; spike 2 mm. thick × 2 cm. long; peduncle slender, 10 mm. long, glabrous; bracts inflexed-cucullate, glabrous or slightly ciliate, glandular-dotted; ovary ovoid, red-glandular-dotted, narrowed at the apex into a very short, thick style, or scarcely stylose; stigmas 3, recurved.

TYPE: locally frequent, wet walls cataract, lower North Ridge Creek, Tafelberg, Surinam, September 19, 1944, *Maguire 24811*. New York Botanical Garden. Known only from the type locality.

PIPER MARGINATUM Jacq. An essentially glabrous shrub or small tree; leaves round-ovate, 10–20 cm. long, with acuminate apex and openly cordate base, palmately 9–11-nerved; petiole to 4 cm. or more long, vaginate-winged to near the blade; spikes 10 cm. or more long. SURINAM: frequent, annual to 1.5 m. high, primary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22739*. A very common species ranging from the West Indies to the mainland and throughout northern South America.

PIPER WACHENHEIMII Trel. A small, shade-loving subshrub to 1.5 m. tall, with densely brown-pilose twigs; leaves elliptic-suboblanceolate, 12–15 cm. long, with acuminate apex and acute base, pinnately nerved below the upper third, villous below; spikes 6 cm. long; fruit hirtellous. BRITISH GUIANA: frequent, in dense second growth in windfall opening, heavy mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22869*. The type was col-

lected by Sandwith on Moraballi Creek near Bartica. Also known from Godebert, French Guiana.

PEPEROMIA R. & P.

Annual or perennial, usually fleshy, epiphytic or terrestrial herbs; sometimes with tuberous or corm-like stems; leaves alternate, opposite or verticillate, lacking stipules; flowers loosely or compactly crowded in a slender terminal, axillary or leaf-opposed spike, subtended by a usually round-peltate bract; stamens 2, stigma 1, fruit drupe-like, with very thin pericarp. Widely distributed throughout the tropical and subtropical regions of the world.

PEPEROMIA ALATA R. & P. A glabrous, assurgent, epiphytic or terrestrial herb up to 30 or more cm. tall, with more or less zig-zag stems rather prominently winged with ridges decurrent from the nodes; leaves alternate lance-elliptic, commonly 6–12 cm. long, with acuminate apex and acute base, palmately 5–7-nerved; spikes 8–15 cm. long, fruit globose-ovoid with oblique apex. SURINAM: frequent on moist mossy rocks, base of north escarpment, vicinity foot of Augustus Falls, Tafelberg, *24757;* infrequent, epiphyte in high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24519.* Distributed throughout northern South America.

PEPEROMIA ELONGATA H.B.K. var. **guianensis** Yuncker, var. nov. Plantae robustiores, caulibus longioribus magis pendulis; folia ex lanceolato-elliptica elliptico-ovata, 7–12 cm. longa, 3–4 cm. lata; petioli 1–2 cm. longi.

Plants more robust than the species, and with longer more pendulous stems; leaves lance-elliptic to elliptic-ovate, 3–4 cm. wide × 7–12 cm. long; petioles 1–2 cm. long. Otherwise similar to the species.

TYPE: Pomeroon District, Kamwatta, British Guiana, September 21, 1921, *La Cruz 1197,* U. S. National Herbarium, no. 1120034; isotype, New York Botanical Garden. BRITISH GUIANA: upper Rupununi River near Dadanawa, *De La Cruz 1520;* Northwest District, Mt. Everard, *De La Cruz 1304;* Anabisi River, *De La Cruz 1365;* epiphyte from rope in mora forest, Takutu Creek to Puruni River, Mazaruni River, *F4929; F4851.* Also from Venezuela.

PEPEROMIA FLABELLA (Sw.) A. Dietr. var. MELANOSTIGMA (Miq.) Dahlst. A rather small, black-dotted epiphyte, glabrous except for ciliate petioles and decurrent lines; leaves alternate, lanceolate, 3–8 cm. long, acute to acuminate at both ends, spikes slender, up to 12 cm. or more long; fruit globose-ovoid with an oblique apex. BRITISH GUIANA: epiphyte on upper branches of a mora tree, Takutu Creek to Puruni River, Mazaruni River, *F4855.* SURINAM: epiphyte in montane forest, Km. 15, Coppenam River Headwaters, *24160.* Also occurs in Venezuela and Colombia.

PEPEROMIA MACROSTACHYA (Vahl) A. Dietr. A trailing or pendent glabrous epiphytic herb; leaves alternate, subovate-elliptic, up to 6–10 cm. long, with acuminate apex and rounded-obtuse or acutish base; 7–9-plinerved, more or less ciliate; spikes slender, up to 20 or 30 cm. long; fruit subcylindric, up to 2 cm. long, with oblique apex. BRITISH GUIANA: growing intimately with *Cordonanthe* in ant nest, along timber trail in high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22837;* rare, along Potaro River, above Kaiatuk, Kaieteur Plateau, *23379.* SURINAM: frequent in ant nest, high, mixed, wallaba forest, Km. 17, vicinity Black Water Camp (5),

Coppenam River Headwaters, *24846*. Rather common throughout northern South America.

PEPEROMIA MAGNOLIAEFOLIA (Jacq.) A. Dietr. A glabrous, succulent, terrestrial or epiphytic herb; leaves more or less alternate, elliptic-obovate, 6–15 cm. long, with rounded apex and cuneate base, pinnately nerved, spikes up to 15–20 cm. long, on a glabrous, bracted stalk 5–10 cm. long; fruit ellipsoidal with a long slender awl-shaped beak. BRITISH GUIANA: locally frequent, wet rocks along river, high mixed forest, Potaro River Gorge, *23522*, epiphyte in mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22825;* Takutu Creek to Puruni River, Mazaruni River, *F4852*. SURINAM: frequent in high forest, base south escarpment, Arrowhead Basin, Tafelberg, *24520;* savanna, east side, Zanderij I, *25054*. A common species in the West Indies and northeastern South America.

Peperomia Maguirei Yuncker, sp. nov. Herba humilis ramosa subrepens et assurgens; caules 2 mm. in diametro, sursum villosi pilis curvato-adscendentibus, deorsum glabrescentes, internodiis 1–3 cm. longis; rami fructiferi adscendentes 5 cm. vel ultra e basi prostrata radicante, in sicco flavonitidi sulcati; folia elliptico-obovata, 12–20 mm. longa, 5–12 mm. lata, apice rotundata emarginata, ad basim acuta, trinervia, costa subtus prominenti, supra laxe pilosa glabrescentia, subtus glabra, in incisura apicali hirtella, in sicco coriacea, subnitentia, opaca, anguste revoluta; petiolus 2–5 mm. longus, pubescens; spicae terminales, 2 cm. longae, 2 mm. in diametro; pedunculus pubescens 1 cm. longus; bracteae rotundato-peltatae, glanduloso-punctatae; fructus ca. 1 mm. longus, globosus, stylo brevi crasso, stigmatibus apicalibus.

A low, subrepent-assurgent, branched epiphytic herb; stems 2 mm. thick, upcurved-villous above, glabrescent below, internodes 1–3 cm. long, fruiting branches ascending to 5 cm. or more from the prostrate rooting base, drying yellow-glossy, sulcate; leaves elliptic-obovate 5–12 mm. wide × 12–20 mm. long, apex rounded, emarginate, base acute, palmately 3-nerved, the midrib prominent beneath, loosely pilose above glabrescent, glabrous beneath, hirtellous in the apical notch, drying coriaceous, somewhat glossy, opaque, narrowly revolute; petiole 2–5 mm. long, pubescent; spikes terminal, 2 mm. thick × 2 cm. long; peduncle 1 cm. long, pubescent; bracts round-peltate; glandular-dotted; fruit about 1 mm. long, globose, with a short thick style, stigmas apical.

TYPE: moist fallen log in high bush, vicinity southeast margin of Arrowhead Basin, Tafelberg, Surinam, August 19, 1944, *Maguire 24420*. New York Botanical Garden. Known only from the type locality.

PEPEROMIA OBTUSIFOLIA (L.) A. Dietr. A succulent, terrestrial or epiphytic herb, glabrous except for the minutely puberulent peduncle; leaves alternate elliptic-obovate mostly 8–12 cm. long, with rounded apex and cuneate base; spikes up to 15 cm. long; fruit ellipsoidal with a slender hooked beak. BRITISH GUIANA: rare, on tree trunks in mixed forest, trail from Tukeit to Kaiatuk Plateau, plateau level, *23090*. SURINAM: frequent, epiphyte in mixed montane high forest, North Ridge, Tafelberg, *24800*. A common species of the West Indies and throughout northern South America.

PEPEROMIA PANICULATA Regel. A short-stemmed succulent epiphyte, essentially glabrous; leaves alternate, elliptic or oblanceolate, 15–20 cm. long, acuminate at both ends, pinnately nerved, spikes about 1 cm. long, numerous

in an elongate spike-like paniculate cluster, the main stalk densely velvety; fruit subcylindrical with obliquely truncated apex. BRITISH GUIANA: epiphyte on *Manicaria* palm, Sebai Creek, Kaituma River, *F5152*. Also from French Guiana and Colombia.

PEPEROMIA PELLUCIDA (L.) H.B.K. A delicate, erect, branched, succulent, glabrous herb; leaves alternate, round-ovate, 1.5–3 cm. wide with acutish apex and subtruncate-cordate base; spikes up to 5 cm. long, fruit ellipsoidal, longitudinally somewhat sulcate-striate, stigma apical. SURINAM: frequent, vicinity Agricultural Experiment Station at Paramaribo, *22716*. A common weedy species found throughout the range of the genus in both hemispheres.

PEPEROMIA ROTUNDIFOLIA (L.) H.B.K. A slender, small, repent, mostly epiphytic plant; stems filiform; leaves alternate, round or round-elliptic, about 1 cm. long, loosely villous; spikes 2 cm. long; fruit globose-ovoid with oblique apex. BRITISH GUIANA: on fallen tree in mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22819*. A common species found throughout the American range of the genus.

PEPEROMIA SERPENS (Sw.) Loud. A small, repent, crisp-pubescent epiphyte or terrestrial herb with slender stems; leaves alternate, round-subdeltoid, 1–2 cm. wide, palmately 3–5-nerved; spikes up to 3 cm. long; fruit ellipsoidal, with long slender beak. BRITISH GUIANA: on fallen tree, Takutu Creek to Puruni River, Mazaruni River, *F4901*. SURINAM: frequent, in swamps, vicinity Base Camp (1), Saramacca River Headwaters, *24092*. A common species found throughout nearly the entire American range of the genus.

Peperomia tafelbergensis Yuncker, sp. nov. Herba gracillima repens epiphytica; caules filiformes, satis laxe villosi, internodiis usque ad 2 cm. longis; rami fructiferi adscendentes usque ad 2–3 cm. longi e basi radicanti; folia valde variabilia, elliptica vel subobovata, 3 × 4 mm, 5 × 12 mm., 8 × 10 mm., vel 8 × 18 mm. lata longaque, apice obtusa, ad basim acuta vel in foliis latioribus obtusa, e basi trinervia, costa sursum furcata, supra laxe villosa, subtus glabra et pallidiore, ciliata, in sicco tenuia, pellucida; petiolus filiformis, 1–2 mm. longus, laxe villosus; spicae terminales, 15–20 mm. longae, 1 mm. in diametro, satis laxe floriferae; pedunculus filiformis, ca. 10 mm. longus, glaber; bracteae rotundato-peltatae, glanduloso-punctatae; fructus ovoideus, ca. 0.5 mm. longus, ad apicem obliquus; stigma subapicali.

A very slender repent epiphyte; stems filiform, rather loosely villous, internodes up to 2 cm. long, fruiting branches ascending to 2 or 3 cm. long from the rooting base; leaves very variable in shape and size, elliptic, subobovate, 3 mm. wide × 4 mm. long, 5 × 12, 8 × 10, or 8 × 18, apex obtuse, base acute or in broader leaves obtuse, palmately 3-nerved with the midrib branched upward, loosely villous above, glabrous and paler beneath, ciliate, drying thin, pellucid; petiole filiform, 1–2 mm. long, loosely villous; spikes terminal, 1 mm. thick × 15–20 mm. long, rather loosely flowered; peduncle filiform, about 10 mm. long, glabrous; bracts round-peltate, glandular-dotted; fruit ovoid, about 0.5 mm. long, apex oblique; stigma subapical.

TYPE: in high forest, base of south cliffs, Arrowhead Basin, Tafelberg, Surinam, August 24, 1944, *Maguire 27170*. New York Botanical Garden.

LACISTEMACEAE

LACISTEMA AGGREGATUM (Berg.) Rusby. BRITISH GUIANA: flowering spikes green, fruit scarlet, ovoid, tree 2–3 m. high, 2 cm. diameter, occasional,

in clearing, wallaba forest, Kaieteur Plateau, *23237*. Generally distributed in the Guianas: Mexico and the West Indies to Peru and the Amazon Basin.

L. AGGREGATUM var. **elongatum** Maguire, var. nov. Plantae similis a typo, sed spicis 3–5 cm. longis, pendentibus, axibusque basibus spicarum pubescentibus.

TYPE: flowers pale yellow, small tree 3 inches in diameter, Mazaruni Station, Mazaruni River, British Guiana, January 21, 1945, *Fanshawe 2200*. New York Botanical Garden. Cotype: small second-growth shrub about clearing, on brown sand, Mazaruni Station, *F.184*. In the widespread typical population the spikes are uniformly 1.5–2 cm. long. *Froes 2026* from Carutapera, Maranhaõ, Brazil, with spikes from 2–3 cm. long approaches in this character the var. *elongatum*.

ULMACEAE

TREMA MICRANTHA (L.) Blume. SURINAM: flowers greenish-white, fruit orange, small tree 8 m. high, primary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22798;* flowers white, small shrub with arching branches, islands in rapids, Saramacca River, between Jacob kondre and Kwatta hede, *23904*. Widely distributed, subtropical and tropical; southern Florida, West Indies, New Mexico, south to Peru, Paraguay and Brazil.

MORACEAE[41]

BROSIMUM GUIANENSE (Aubl.) Huber. BRITISH GUIANA: tree 12 m. high, the trunk 7 cm. in diam., greenheart forest on hill slope, leaves somewhat leathery, latex pale orange, fruits pale yellow, Mazaruni Station, *F539;* tree 21 m. high, the trunk 30 cm. in diam., mixed forest on brown sand, latex faintly yellow, not buttressed, local name Tibikushi, Mazaruni Station, *F630*. SURINAM: small tree to 7 m. high, infrequent, low forest 1 km. south of Savanna No. I, 570 m., alt., Tafelberg, *24358*. Guianas, northern Brazil, Bolivia(?).

Brosimum rotundatum Standl., sp. nov. Arbor alta fere glabra, ramulis gracilibus teretibus fusco-ferrugineis, sparse puberulis, cito glabratis, internodiis brevibus; stipulae parvae triangulari-ovatae 3–4 mm. longae brunneae acutiusculae caducae, sparse puberulae, mox glabratae; folia inter minora breviter petiolata firme chartacea, petiolo 4–5 mm. longo, sparse puberulo glabrescente; lamina anguste obovato-oblonga 4.5–8.5 cm. longa 2.5–3.5 cm. lata, apice late vel anguste rotundata, basin obliquum versus angustata, uno latere obtusa, altero acutissima, supra lucida glabra, costa nervisque obviis sed vix prominulis, subtus pallidior brunnescens, primo minutissime sparseque puberula, cito glabrata, costa tenera prominente, nervis lateralibus utroque latere ca. 14 teneris prominulis angulo lato abeuntibus fere rectis, remote a margine in nervum collectivum arcuato-conjunctis, venulis vix prominulis arcte reticulatis; pedunculi axillares solitarii plerumque 8–13 mm. longi graciles, glabri vel minute sparseque puberuli; capitula florifera 4–5 mm. lata, pauciflora; flores feminei 2 (vel ultra?); bracteae peltatae orbiculares, minutissime ciliolatae.

TYPE: tree 25 mm. high, the trunk 30 cm. in diam., not buttressed, from low "near" wallaba forest, latex pale yellow, fairly plentiful, leaves glauces-

[41] By Paul C. Standley.

cent beneath, receptacle turning yellow and orange as it ripens, vernacular name Tibikushi, Siba Creek, April 23, 1941, British Guiana, *Fanshawe 688.* Chicago Natural History Museum; New York Botanical Garden.

Referable to the group sometimes separated as a distinct genus, *Piratinera.* Noteworthy for the rounded apices of the leaves.

BROSIMUM VELUTINUM (Blake) Ducke. BRITISH GUIANA: tree 5 m. high, the trunk 10 cm. in diam., flower heads yellow, fruit scarlet, soft, fleshy, warty, obconical, occasional, below Tukeit, Potaro River Gorge, *23490.* British Guiana, Surinam, northern Brazil.

COUSSAPOA ANGUSTIFOLIA Aubl. SURINAM: tree 12 m. high, the trunk 20 cm. in diam., fruit yellowish, Jacob kondre, Saramacca River, *23867;* river banks above Kwatta hede, Saramacca River, *23942.* French Guiana.

I have seen no other material of this species, but the present collection agrees so well with Aublet's original illustration that there is little doubt that the Surinam tree is referred properly here.

COUSSAPOA MICROCEPHALA Trécul. BRITISH GUIANA: rope growing as shrub at cliff edge overlooking Kaieteur Gorge, Kaieteur Plateau, flowers pale cream, occasional, *23449.* SURINAM: tree to 15 m. high, the trunk 20 cm. in diam., no latex, forest slopes, 0.5 km. south of East Ridge, Tafelberg, 920 m., alt., *24588.* Known only from Surinam and British Guiana.

FICUS ALBERT-SMITHII Standl. BRITISH GUIANA: tree 3–4 m. high, the trunk 6 cm. in diam., copious latex, leaves rigid, leathery, fruit pink, occasional, bush island in savanna, Kaieteur Plateau, *23123;* tree 2–3 m. high, 8 cm. diam., fruit pink, globose, latex copious, occasional, Kaieteur savannas, *23214.* Known previously only from the type, from Kanuku Mountains, British Guiana.

FICUS ANGUSTIFOLIA Miq. BRITISH GUIANA: tree 30 m. high, the trunk 40 cm. in diam., the irregular spreading buttresses 2 m. high, originally epiphytic on an *Eschweilera* which it has not quite enveloped, fruit green, Groete Creek, lower Essequibo River, *F1987;* vernacular name Kumakaballi. Guianas, Venezuela, northern Brazil.

Ficus arctocarpa Standl., sp. nov. Subg. *Urostigma.* Arbor epiphytica, ramulis ca. 6 mm. diam. crassis pallidis vel brunneis dense adpresso-pilosis internodiis brevissimis vulgo 7 mm. longis vel breviorbus; stipulae longe persistentes anguste triangulari-ovatae brunneae ca. 1.5 cm. longae longi-acuminatae, extus brunneo-pilosae vel serius glabratae; folia modica breviter petiolata, petiolo crassiusculo usque ad 1 cm. longo, vulgo breviore, piloso; lamina oblonga vel oblanceolato-oblonga 9–12.5 cm. longa 3–5.5 cm. lata, acuta vel abrupte apiculato-acuta, acumine obtuso, basin versus plus minusve angustata, basi ipsa obtusa, coriacea, supra in sicco fusca, costa plana vel impressa, nervis impressis, glabra, subtus brunnescens, ad costam nervosque brunneo-pilosa, aliter puberula vel glabrata, costa crassiuscula elevata, nervis lateralibus utroque latere ca. 9 prominentibus angulo lato adscendentibus, fere rectis, prope marginem in nervum collectivum irregularem arcuato-conjunctis, venulis prominulis reticulatis; receptacula arcte sessilia globosa 6–8 mm. diam. ubique densissime pilis longis brunnescentibus intertextis induta, ostiolo parvo, foliolis suberectis; involucrum bilobum ca. 4 mm. latum, extus dense adpresso-pilosum, lobis apice rotundatis, arcte adpressum.

TYPE: a strangler with trunk 10 cm. in diam., infrequent, bush to rear

of Jacob kondre, June 19, 1944, Saramacca River, Surinam, *Maguire 23865.* Chicago Natural History Museum; New York Botanical Garden.

In most characters this is like *F. Maguirei*, described on a following page. In that the receptacles are glabrous, while in *F. arctocarpa* they are very densely covered with long, more or less matted, shaggy hairs.

Ficus arukensis Standl., sp. nov. Subg. *Urostigma.* Arbor alta omnino glabra, ramulis cinnamomeis ca. 5 mm. crassis; stipulae caducae triangulari-ovatae ca. 17 mm. longae anguste acuminatae brunneae; internodia brevia; lamina folii anguste oblonga 9.5–17.5 cm. longa, 3.5–6 cm. lata, apice subrotundata atque abrupte cuspidato-acuminata, acumine 1–1.5 cm. long acuto, basi rotundata vel obtusissima, fere concolor, costa supra apicem versus prominente, basin versus sulcata, nervis venulisque prominentibus vel prominulis, costa subtus gracili prominente, nervis lateralibus utroque latere ca. 12 teneris prominulis angulo fere recto divergentibus fere rectis juxta marginem arcuato-conjunctis; pedunculi geminati crassi vix ultra 3 mm. longi et fere aequilati; involucrum bilobum ca. 6 mm. latum, lobis rotundatis; receptacula globosa 10–12 mm. diam. glabra, ostiolo apice prominente.

TYPE: epiphytic tree 12 m. tall, 10 cm. diam., latex white, leaves pale beneath, *Manicaria* swamp forest fringe, Mabaruma, Aruka River, N. W. D., British Guiana, March 23, 1945, *Fanshawe 2435.* Chicago Natural History Museum; New York Botanical Garden. Wanama River, N. W. D., May, 1923, *La Cruz 3983.*

The latter collection was once determined by the writer as *F. paraensis* Miq., to which the present species is related.

Ficus erratica Standl., sp. nov. Subg. *Urostigma.* Arbor omnino glabra, ramulis gracilibus 3–5 mm. tantum crassis, internodiis brevibus; stipulae caducae brunnescentes triangulari-lanceolatae 12–18 mm. longae (vel ultra?) longe anguste attenuato-acuminatae; folia modica petiolata in sicco subcoriacea, petiolo crasso 8–17 mm. longo; lamina elliptico-oblonga vel interdum obovato-oblonga, 8.5–15 cm. longa 4–7 cm. lata, abrupte acuta vel breviter cuspidato-acuminata, basin versus paullo angustata, basi ipsa acuta vel obtusa, fere concolor, costa supra fere plana, nervis prominulis, costa subtus prominente crassiuscula, nervis lateralibus utroque latere ca. 12 angulo lato divergentibus rectis teneris, prope marginem in nervum collectivum irregulare arcuato-conjunctis, venulis pallidis prominulis arcte reticulatis; pedunculi geminati graciles 3–4 mm. longi, minutissime puberuli vel glabri; involucrum bilobum patens 3.5 mm. latum, lobis apice rotundatis; receptacula globosa 6–7 mm. diam., basi et apice late rotundata, ostiolo paullo prominente.

TYPE: epiphytic tree 15 m. high, 15 cm. diam., leaves leathery, pale beneath, fruit pink to red, *Manicaria* swamp forest fringe, Mabaruma, Aruka River, N. W. D., British Guiana, March 23, 1945, *Fanshawe 2436;* vernacular name Komakaballi. Chicago Natural History Museum; New York Botanical Garden. BRITISH GUIANA: Malali, Demerara River in 1922, *La Cruz 2639.* SURINAM: weak slender tree or liana, dense *Clusia* bush 2 km. west of Last Ridge, Tafelberg, 786 m., *24563.*

Ficus Fanshawei Standl., sp. nov. Subg. *Urostigma.* Arbor alta, ramulis ca. 5 mm. crassis brunnescentibus, internodiis brevibus, novellis sparse pilis longis pallidis patentibus hirsutis; stipulae caducae, bene evolutae non

visae, in alabastris late ovato-triangulares 8 mm. longae longiacuminatae dorso brunneo-pilosae; folia modica petiolata membranaceo-coriacea, petiolo crasso 12–25 mm. longo brunneo-piloso vel glabrato; lamina elliptica vel oblongo-elliptica 10–16.5 cm. longa 4.5–8 cm. lata, apice acuta vel obtusa vel rotundata et breviter apiculata, interdum rotundata, base rotundata vel late obtusa, costa supra prominente, nervis tenerrimis prominulis, supra ad costam nervosque puberula vel glabrata, subtus pallidior, ad costam nervosque sparse pilosa vel puberula, serius glabrata, costa elevata, nervis lateralibus utroque latere ca. 8 angulo lato adscendentibus arcuatis, juxta marginem arcuato-conjunctis teneris, venulis prominulis laxe reticulatis; pedunculi geminati crassi vix ultra 3 mm. longi brunneo-pilosi; involucrum bilobum 3 mm. latum sparse brunneo-pilosum; receptacula globosa immatura 8–10 mm. longa, minutissime denseque puberula, ostiolo prominente annuliformi 2.5–3 mm. lato 1 mm. alto.

TYPE: epiphytic tree 15 m. high, 30 cm. diam., leaves thinly leathery, clustered at ends of branches, young fruit pale green, with paler dots, with membranous crown, edge of *Euterpe* swamp by roadside, Mabaruma, Aruka River, N. W. D., British Guiana, March 6, 1945, *Fanshawe 2363;* vernacular name Komakaballi. Chicago Natural History Museum; New York Botanical Garden.

FICUS GIGANTEA H.B.K. BRITISH GUIANA: epiphytic tree 9 m. high, the trunk 10 cm. diam., latex whitish, young fruit ovoid, green with paler dots, *Manicaria* swamp forest fringe, Mabaruma, Aruka River, N. W. D., *F2433*, vernacular name Komakaballi. Venezuela, Colombia (?).

There is some uncertainty regarding the determination of this collection, but the British Guiana tree is at least so close to the species named that it is unsafe to propose it as new.

FICUS GLAUCESCENS (Liebm.) Miq. BRITISH GUIANA: tree to 30 m. high, the buttresses 3.5–4.5 m. high, frequent, lateritic soil, mixed forest, White Creek, Essequibo River, *22877*. Mexico and Central America; Colombia to northern Brazil.

Ficus Maguirei Standl., sp. nov. Subg. *Urostigma.* Arbor interdum epiphytica, ramulis ca. 6 mm. diam., pilis longis laxis patentibus dense hirsutis vel pilosis, internodiis brevissimis plerumque multo minus quam 1 cm. longis; stipulae longe persistentes fusco-brunneae lanceolato-triangulares vulgo 1.5–2 cm. longae, longiatenuatae, extus dense adpresso-pilosae, intus glabrae; folia modica coriacea breviter petiolata, petiolo crasso 7–12 mm. longo dense piloso; lamina anguste oblonga vel oblanceolato-oblonga 8.5–14 cm. longa 2.5–4.5 cm. lata, breviter subabrupte acuminata, acumine obtuso, basin versus angustata, basi ipsa obtusa et subemarginata, supra in stato adulto glabra vel glabrata, ubique minute puncticulata, in sicco fuscescens, costa nervisque impressis, nervulis obsoletis, subtus paullo pallidior brunnescens, ad nervos costamque pilosa serius glabrata, costa crassiuscula elevata, nervis lateralibus utroque latere ca. 10 adscendentibus arcuatis elevatis prope marginem prominente arcuato-conjunctis, venulis prominentibus vel prominulis arcte reticulatis; receptacula arcte sessilia geminata globosa glabra 8–9 mm. diam., ostiolo majusculo prominente; involucrum bilobum arcte adpressum ca. 5 mm. latum, extus dense adpresso-pilosum.

TYPE: rare tree 10 m. high, 30 cm. diam., fruit black, splotched with green, *Dicymbe* forest, Tukeit, Potaro River Gorge, British Guiana, May 17,

1944, *Maguire & Fanshawe 23528.* Chicago Natural History Museum; New York Botanical Garden.

FICUS MALACOCARPA Standl. BRITISH GUIANA: epiphytic tree 6 m. high, the trunk 10 cm. in diam., with spreading crown, latex watery, white, leaves clustered at ends of branches, fruit greenish, dotted with brown and white, fringing a *Manicaria* swamp, Mabaruma, Aruka River, N. W. D., *F2386.* Known only from British Guiana, where collected several times.

Ficus Manicariarum Standl., sp. nov. Subg. *Urostigma.* Arbor, ramulis ca. 5 mm. crassis, internodiis brevibus, dense puberulis; stipulae caducae lanceolato-triangulares longiacuminatae fere 2 cm. longae extus minute puberulae; folia modica longipetiolata subcoriacea, petiolo gracili vel crassiusculo 1.5–3.5 cm. longo minute puberulo; lamina elliptica vel late elliptica 11–14 cm. longa 6–8 cm. lata, abrupte breviterque cuspidato-acuta, basi late rotundata, supra glabra, costa plana, nervis lateralibus pallidis vix prominulis, subtus pallidior, ubique minute brunneo-puberula, costa gracili elevata, nervis lateralibus utroque latere ca. 9 angulo paullo latiore quam semirecto adscendentibus, fere rectis, prope marginem irregulariter arcuato-conjunctis, venulis prominulis laxe reticulatis; pedunculi geminati crassi vix ultra 2 mm. longi; involucrum 5 mm. latum bilobum, extus minute puberulum, patens vel reflexum, lobis apice rotundatis; receptacula globosa 13 mm. diam. glabra vel glabrata, basi et apice rotundata, ostiolo vix elevato 3 mm. lato.

TYPE: epiphytic tree 12 m. high, 15 cm. in diam., latex white, leaves leathery, fruit green, soft, *Manicaria* swamp forest fringe, Mabaruma, Aruka River, N. W. D., British Guiana, March 23, 1945, *Fanshawe 2434;* vernacular name Komakaballi. Chicago Natural History Museum; New York Botanical Garden.

FICUS MARTINI Miq. SURINAM: strangler, fruit sweet, succulent, red, the pulp red, riverside en route to Pakka Pakka, Saramacca River, *23962.* French Guiana.

Ficus mensalis Standl., sp. nov. Subg. *Urostigma.* Arbor glabra, ramulis 4–5 mm. crassis, apicem versus foliatis; stipulae caducae, non visae; folia parva petiolata coriacea rigida, petiolo crasso 9–12 mm. longo; lamina obovato-elliptica vel oblongo-elliptica 6–9.5 cm. longa 2.7–4 cm. lata, subabrupte acuta vel acuminata, acumine obtuso vel acuto, basi acuta vel subobtusa, supra lucida, costa nervisque prominulis, venulis obsoletis, subtus concolor, costa crassa prominente, nervis lateralibus utroque latere ca. 10 angulo recto patentibus teneris fere rectis, juxta marginem in nervum collectivum conjunctis, venulis prominulis inconspicuis laxe reticulatis; pedunculi geminati 3 mm. longi; involucrum bilobum vix ultra 2.5 mm. latum patens, lobis apice rotundatis; receptacula globosa glabra 5–6 mm. lata, basi et apice late rotundata, ostiolo vix 2 mm. lato plano.

TYPE: diffuse tree overhanging escarpment, the trunk 20 cm. in diam., fruit red, 2 km. south of East Ridge, alt. 920 m., Tafelberg, Surinam, September 1, 1944, *Maguire 24584.* Chicago Natural History Museum; New York Botanical Garden.

Ficus pakkensis Standl., sp. nov. Subg. *Urostigma.* Arbor, ramulis 6–7 mm. crassis dense minuteque puberulis, internodiis brevibus; stipulae (bene evolutae non visae) ovato-triangulares, caducae, 1 cm. longae vel ultra, longiacuminatae, extus dense puberulae; folia modica longipetiolata coriacea,

petiolo crasso 2.5–4 cm. longo minute puberulo; lamina oblonga vel elliptico-oblonga 10–16 cm. longa 4.5–6.5 cm. lata, apice rotundata, basi anguste rotundata et saepe emarginata, supra glabra, minute pallido-puncticulata et tactu asperula, costa plana, nervis vix prominulis, subtus fere concolor, ubique minute puberula, costa crassiuscula prominente, nervis lateralibus utroque latere ca. 8 angulo lato adscendentibus fere rectis juxta marginem inaequaliter arcuato-conjunctis, venulis prominulis arctissime reticulatis; pedunculi geminati ca. 8 mm. longi minute puberuli; involucrum bilobum ca. 4 mm. latum patens vel subreflexum minutissime puberulum; receptacula globosa vel obovoideo-globosa 14–16 mm. alta, basi rotundata, minute puberula, apice late rotundata, ostiolo paullo elevato fere plano.

TYPE: tree, riverside en route to Pakka Pakka, Saramacca River, Surinam, June 24, 1944, *Maguire 23960*. Chicago Natural History Museum; New York Botanical Garden.

This species is remarkable for the close reticulation of the lower leaf surface, the veinlets being so enlarged that they almost completely cover the leaf tissue.

Ficus paludica Standl., sp. nov. Subg. *Urostigma*. Arbor alta, ramulis gracilibus ca. 4 mm. crassis minutissime puberulis, internodiis brevibus; stipulae caducae lanceolato-triangulares 1.5 cm. longae (et ultra?) longe angusteque attenuato-acuminatae brunneae extus minute puberulae; folia majuscula longipetiolata crasse membranacea, petiolo gracili 3.5–4.5 cm. longo fere glabro; lamina ovalis vel late ovato-ovalis ca. 15 cm. longa et 9–10.5 cm. lata, apice rotundata vel obtusa et obtuse breviter apicata, basi late atque breviter cordata, utrinque saltem in statu adulto glabra, supra in sicco fusco-viridis, costa plana, nervis vix prominulis, subtus concolor, costa crassiuscula prominente, nervis lateralibus utroque latere ca. 10 teneris angulo fere semirecto divergentibus, fere rectis, juxta marginem laxe arcuato-conjunctis, venulis prominulis laxe reticulatis; pedunculi geminati vix 2 mm. longi et aequilati; involucrum 6 mm. latum bilobum patens minutissime puberulum; receptacula globosa 1 cm. diam. basi et apice rotundata, minutissime puberula vel glabrata, ostiolo 2 mm. lato paullo elevato.

TYPE: infrequent tree 20 m. high, 30 cm. diam., edge of swamp, open scrub land, second growth, bordered by swamps and marshes, Charlesburg Rift, 3 km. north of Paramaribo, Surinam, April 8, 1944, *Maguire & Stahel 22790*. Chicago Natural History Museum; New York Botanical Garden.

FICUS PRINOIDES Humb. & Bonpl. SURINAM: frequent, small tree, receptacles white dotted with green or brown, river banks above Kwatta hede, *23928*. Colombia to Venezuela and Surinam.

Ficus savannarum Standl., sp. nov. Subg. *Urostigma*. Arbor epiphytica, omnino glabra vel in partibus novellis minutissime puberula, ramulis ca. 4 mm. crassis, internodiis brevibus; stipulae caducae, bene evolutae non visae, 7 mm. longae et ultra, acuminatae; folia modica longipetiolata subcoriacea, petiolo crasso 2–3 cm. longo; lamina elliptica 10–12.5 cm. longa 5.5–6.5 cm. lata, abrupte cuspidato-acuminata, basi subacuta usque subrotundata, sat dense papilloso-punctata, costa supra plana, nervis vix prominulis, costa subtus prominente, nervis lateralibus utroque latere ca. 9 angulo lato divergentibus fere rectis, prope marginem inaequaliter arcuato-conjunctis, venulis prominulis laxe reticulatis; pedunculi geminati crassi ca. 4 mm. longi, involucro bilobo ca. 3.5 mm. lato, lobis apice rotundatis patentibus; recepta-

cula globosa 13 mm. diam. basi et apice rotundata glabra, ostiolo insigniter elevato crateriformi, medio depresso, 4 mm. lato, foliolis prominentibus convexis.

TYPE: epiphytic tree 7 m. high, the trunk 15 cm. in diam., copious latex, fruit green, globose, rare, edge of high forest, British Guiana, *Maguire & Fanshawe 23292.* Chicago Natural History Museum; New York Botanical Garden.

FICUS VELUTINA Willd. SURINAM: tree, vicinity of Posoegronoe, Saramacca River, *24039.* Central America, Colombia, Venezuela.

The determination of the Surinam collection is somewhat questionable, but it has been impossible to refer it satisfactorily elsewhere, and it seems inadvisable to describe it as new until this particular group of *Ficus* has been studied more thoroughly.

OGCODEIA GUIANENSIS Mildbr. BRITISH GUIANA: tree to 20 m., the trunk 20 cm. in diam., creamy latex, fruits 5 cm. long, mixed forest, Kamuni Creek, Essequibo River, *22947.* Known only from British Guiana.

Olmedia asperula Standl., sp. nov. Arbor gigantea, ramulis gracilibus vix 4 mm. crassis, dense puberulo-tomentellis, internodiis abbreviatis; stipulae bene evolutae non visae, in alabastris lanceolato-ovatae acuminatae 6 mm. tantum longae, dense adpresso-pilosulae, caducae; folia modica breviter petiolata coriacea, petiolo crasso 6–10 mm. longo dense pilis flavidis adpresso-pilosulo; lamina oblonga vel anguste oblonga 8–15 cm. longa 4–5.5 cm. lata, apice rotundata vel obtusa atque abrupte breviter acuminato-apiculata, basi obtusa vel anguste rotundata et saepe inaequilateralis, supra in sicco fuscescens, ubique scaberula, tactu asperula, ad costam dense minuteque hispidula, nervis non elevatis, subtus pallidior brunnescens, ubique dense puberula vel fere minute hispidula, costa elevata, nervis lateralibus utroque latere ca. 12 angulo lato adscendentibus, subarcuatis, gracilibus, juxta marginem inaequaliter arcuato-conjunctis, venulis elevatis et arctissime reticulatis; pedunculi axillares vel ad nodos defoliatos fasciculati ca. 8 mm. longi graciles dense puberuli; capitula mascula depresso-globosa 7 mm. lata multiflora; bracteae exteriores numerosissimae gradatim imbricatae, ovatae vel late ovatae, acutiusculae, extus dense minute puberulae

TYPE: tree 30 m. high, the trunk 30 cm. in diam., with thick brittle bark and palest yellow gummy latex; sapwood yellow, the heartwood dark chestnut with black markings like Tibikushi, tree has scent of almond essence, greenheart bush on brown sand, Moraballi Creek, Essequibo River, alt. 45 m., British Guiana, November 26, 1938, *Fanshawe 148.* Chicago Natural History Museum; New York Botanical Garden.

POUROUMA GUIANENSIS Aubl. BRITISH GUIANA: tree 18 m. high, 30 cm. diam., with buttresses to 2 m. tall, Takutu Creek to Puruni River, Mazaruni River, *F2050;* vernacular name Burume.

PROTEACEAE[42]

PANOPSIS SESSIFOLIA (Rich.) Sandwith. BRITISH GUIANA: tree 6 m. high, 20 cm. diameter, leaves whorled, fruit globose, green, buoyant, pithy, pendent, 1–6 per spike, riverside above Kaiatuk, Kaieteur Gorge, Potaro River, *23372;* 40′ tree, 8″ diameter, leaves herbaceous, flowers in terminal

[42] A. M. W. Mennega.

spikes, thickly clustered, pink, corolla lobes ligulate, whitish with an inner flap, Moraballi Creek, Essequibo River, *F304*. Rain-forest, southern Venezuela to Brazil.

LORANTHACEAE

ORYCTANTHUS BOTRYOSTACHYS Eichl. BRITISH GUIANA: parasitic on *Anacardium*, Garraway Stream, Potaro River, *22996*. Widely distributed in rain-forests, Colombia, Venezuela, and French Guiana to Peru, Bolivia and Brazil.

ORYCTANTHUS FLORULENTUS (Rich.) Urban. SURINAM: parasitic on *Bellucia grossularioides* (L.) Triana, Pakka Pakka, Saramacca River, *23972;* Savanna II, Tafelberg, *27202*. Colombia and the Guianas to Peru and Brazil.

PHORADENDRON CRASSIFOLIUM Eichl. BRITISH GUIANA: leaves yellow-green, flowers yellowish, fruit 4 mm. diameter, pale orange, Kaieteur Plateau, *23136;* epiphyte in secondary mixed forest, leaves fleshy, flower spikes yellowish, fruit oblong, pulpy, orange, Moraballi Creek, Essequibo River, *F1334*. SURINAM: parasite on *Bellucia grossularioides* (L.) Triana, growing with *Oryctanthus florulentus* (Rich.) Urban and *Phthirusa pyrifolia* (HBK.) Eichl., Pakka Pakka, Saramacca River, *23974*. Central America: British Honduras and Costa Rica; South America: Venezuela and the Guianas to Brazil, Bolivia and Peru.

Phoradendron Fanshawei Maguire, sp. nov. *Paradoxae*, *Fendlerianae*. Frutex parasiticus, dichotome ramosis; cataphyllis 3 per nodis; foliis crassis, obovatis; spicis cum 3–4 nodis, floribus 6-serratis.

Dichotomously branched, the branches thick, terete, minutely muriculate, swollen below the nodes, internodes 4–6 cm. long; cataphylls ca. 2 mm. long, 3 pair, sterile, obtuse, broadly triangular-connate for more than half their length, the first pair basal, the uppermost just above the midpoint of the node; leaves opposite, mostly 5.0–7.5 cm. long and 3.0–3.5 cm. broad, obovate-oblanceolate, coriaceous, drying minutely verruculose and rugulose, obscurely or not visibly basinerved, the apex rounded, the blade cuneate from about the middle, passing into a broad petiole 2–3 mm. long or subsessile; apparently dioecious, spikes axillary, solitary or several, usually 3–4 cm. long, bearing 3 pairs of cataphylls and 3–4 floriferous, clavate nodes, peduncles ca. 1 cm. long; flowers 3 or mostly 4 in 6 vertical series, hence ca. 24 per joint, conspicuously sunk into the axis, yellow, trimerous; fruit unknown; staminate plant unknown.

TYPE: epiphyte on *Terminalia*, Potaro River Gorge below Tukeit, British Guiana, May 16, 1944, *Maguire & Fanshawe 27201*. New York Botanical Garden; isotype at Kew.

Most closely related to *P. Fendlerianum* Eichler of the *Paradoxae*, from Venezuela, *P. Fanshawei* differs most conspicuously in its obovate-oblanceolate, cuneate blades, subsessile or with petioles 2–3 mm. long, rather than "Leaves round-ovate or elliptical, sometimes oblique, very obtuse, or emarginate, . . . rather abruptly petioled for some 10 mm."

PHORADENDRON JENMANI Trelease. BRITISH GUIANA: growing on *Norantea guianensis* Aubl., flowers greenish-yellow, occasional, Kaieteur Plateau, *23134*. Known only from British Guiana.

PHORADENDRON RACEMOSUM Northrop. SURINAM: parasitic in large tree, high mixed forest, south rim Arrowhead Basin, Tafelberg, *24655*. Widely

distributed in tropical America, according to Trelease from the upper West Indies, Venezuela and the Guianas.

PHORADENDRON ZULOAGAE Trelease. SURINAM: parasitic on small trees, fruit orange, White Rock Rapids, below Posoegronoe, Saramacca River, *24008*. Infrequently collected, Trinidad, Venezuela, and now Surinam.

Phthirusa adunca (Meyer) Maguire, comb. nov. *Loranthus aduncus* Meyer, Prim. Fl. Esseq. 149. 1818; *L. paniculatus* H.B.K. Nov. Gen. & Sp. **3**: 422. 1820; *L. conduplicatus* H.B.K. op. cit.; *L. Theobromae* Willd. ex R. & S. Syst. **7**: 132. 1829; *Struthanthus aduncus* (Meyer) G. Don. Gen. Syst. **3**: 414. 1834; *Phthirusa Theobromae* Eichl. in Mart. Fl. Bras. **5**^{2}: 56. 1868; *P. paniculata* Macbr. Field. Mus. Bot. **11**: 17. 1931; *Struthanthus aduncus* (Meyer) G. Don. in Macbr. Fl. Peru, Field Mus. Publ. Bot. 2^2: 411. 1937. BRITISH GUIANA: parasite on *Anacardium*, Garraway Stream, Potaro River, *22995*. Widespread in much of tropical South America; Colombia, Venezuela, Trinidad, the Guianas, Brazil, Bolivia, and Peru. Maintenance of the Genus *Phthirusa* makes the above combination necessary.

PHTHIRUSA ANGULATA Krause. BRITISH GUIANA: flowers pale cream, fruit red, frequent, parasitic on lime tree, Mazaruni Forest Station, Mazaruni River, *23578*. Described from the Coppenam River, Surinam, the species is now known apparently from British Guiana and Dutch Guiana (Surinam). It is probably most closely related to *P. pyrifolia* which it simulates in general habit and reflected fruits, but differs in angled, glabrous branches rather than scurfy, terete branches in *P. pyrifolia*.

PHTHIRUSA PHAEOCLADUS Eichl. *Struthanthus phaeocladus* (Eichl.) Macbr. BRITISH GUIANA: frequent epiphyte on low trees, branches red, leaves pale brownish-red, fruit pale orange, Kaieteur Savanna, *23278*. It would seem not unlikely that the above, *Phthirusa guyanensis* Eichl. and *P. santaremensis* Eichl. are conspecific, and therefore all should come under the last name. *P. phaeocladus* in the restricted sense is apparently known from British Guiana, Peru and Brazil.

PHTHIRUSA PYRIFOLIA (H.B.K.) Eichl. SURINAM: growing on *Bellucia grossularioides* (L.) Triana with *Oryctanthus florulentus* (Rich.) Urban, and *Phoradendron crassifolium* Eichl., Pakka Pakka, Saramacca River, *23973*. Widespread in Central America and tropical South America.

PHTHIRUSA SQUAMULOSA Klotzsch ex Eichl. BRITISH GUIANA: epiphytic vine attached to host by haustoria, but rooted in the ground, tomentum dark brown, fruit purplish, rare, Kaieteur Savanna, *23194*. SURINAM: parasitic on *Licania crassifolia*, flowers red, fruit purplish, South Savanna, Zanderij I, *24972*. British Guiana, Surinam, and Pará.

Phthirusa savannarum Maguire, sp. nov. Ramis fusco-purpureis furfuraceis, glabrescentibus; laminis foliarum coriaceis, late ovatis, ellipticooblongis vel orbiculatis, venis obsoletis, subtus mediis nerviis marginibusque laminarum late fusco-purpureis; glomerulis axillaribus ternationibus; floribus hermaphroditis: petalis 6, rariter 5 vel 4; antheris sine appendicibus.

Scandent semi-parasite; branchlets angled, furfuraceous, soon becoming glabrous, dark brownish-purple, otherwise the plant completely glabrous; leaves opposite, blades coriaceous, broadly ovate, elliptic-oblong to orbicular, 1.2–2.5 cm. long, 1–2 cm. wide, veins obsolete, midrib broadly and sometimes irregularly pigmented, petioles angled, 2–3 mm. long, petioles, midrib, and leaf margins dark brownish-purple; glomerules axillary, ternations sessile;

flowers hermaphrodite or sometimes only staminate; calyculus 1.5 mm. long, triangular, carinate, the apex triquetrous, subulate, calyx shallowly lobed, ca. 0.5 mm. long; petals 6 (rarely 5 or 4), 1 mm. long, 0.3–0.4 mm. wide, oblong, deeply cucullate at the obtuse or acutish apex; filaments free, glabrous, slender with an expanded base, 0.2–0.3 mm. long, anther sacs ellipsoidal, pendent, ca. 0.25 mm. long, wholly separated by the connective that does not at all or barely projects apically as a low blunt appendage; style columnar; mature fruit unknown.

TYPE: semi-parasite on shrub, flowers yellowish-green, immature fruit green, leaves coriaceous, Savanna II, 565 m. altitude, Tafelberg, Surinam, September 12, 1944, *Maguire 24702*. New York Botanical Garden.

Phthirusa savannarum belongs to the species group with ternations in axillary glomerules, therefore is related to *P. micrantha* Eichl, *P. Myrsinites* Eichl., and *P. monetaria* Sandw. Our species is distinctive by its coriaceous, veinless, broadly rounded leaves with pigmented margins and midrib, subulate calyculus, and non-appendiculate anthers.

Phthirusa Sandwithii Maguire, sp. nov. Ramis furfuraceis, fuscis; laminis foliorum subcoriaceis, oblanceolatis, apiculatis aliquando retusis, 5–7-nerviis; glomerulis axillaribus, ternationibus sessilibus; floribus hermaphroditis, petalis 4; staminibus adnatis, antheris 4-lobis; stylis clavatis.

Scandent, semi-parasite; branchlets furfuraceous, fuscous, becoming glabrous and ribbed (when dry); leaves opposite, subopposite, or alternate, the blades 2.0–3.5 cm. long, 1.2–1.8 cm. broad, oblanceolate, the apex rounded or retuse, minutely apiculate, faintly 5–7-nerved above, the midrib more or less prominent and fuscous on the under surface, subcoriaceous, the margins narrow, likewise pigmented, petioles 2–3 mm. long, ribbed; glomerules axillary, ternations sessile; flowers hermaphrodite; calyculus scurfy, subcarinate, triangular, acutish or obtuse, ca. 2 mm. long; calyx ca. 0.75 mm. long with low broad lobes; petals 4, oblong, 1.5–1.7 mm. long, hardly cucullate; stamens completely adnate to the petals, the anthers 4-lobed, without appendages; style clavate, 0.75 mm. long; fruit unknown.

TYPE: parasitic on small bushes on rocky ground near the Falls, leaves brownish-green, flowers greenish-yellow, Kaieteur Savanna, British Guiana, 1200 feet altitude, September 6, 1937, *Sandwith 1404*.

Phthirusa Sandwithii is most closely related to *P. micrantha*, having fairly similar leaves and like that species in having 4-merous flowers, but the petals are oblong and 1.5 mm. long, rather than ovate and 1 mm. long; the stamens are completely adnate with broad swollen bases and the anthers 4-lobed by the sterilization of central tissue of each anther sac, rather than bilobed; and the styles are conspicuously clavate with an enlarged ellipsoid stigma rather than being essentially cylindric without enlarged stigmas.

PSITTACANTHUS CUCULLARIS (Lam.) Blume. SURINAM: parasitic on leguminous tree, flowers yellow, bracts red, fruits apparently turning red, frequent, Saramacca River, 7 hours above Posoegronoe, *24920*. Surinam to Brazil and Peru.

PSITTACANTHUS LASIANTHUS Sandw. BRITISH GUIANA: epiphyte with woody stock on trees, frequent, chiefly along rivers, leaves fleshy, glaucous, buds yellow, flowers scarlet, apically yellow, mixed forest, Kaieteur Plateau, near summit of trail to Tukeit, *23077*. Known only from the Kaieteur Plateau, and White Side River, British Guiana.

STRUTHANTHUS DICHOTRIANTHUS Eichl. BRITISH GUIANA: parasite on lime tree, Mazaruni Forest Station, Mazaruni River, *23577;* data same as preceding, *F774*. Rain-forests, Colombia, Venezuela, Trinidad, British Guiana, Brazil and Peru.

OLACACEAE[43]

HEISTERIA CAULIFLORA Sm. SURINAM: frequent, scattered, shrub, sepals red, Campo Dungeoman, Saramacca R., *24056;* frequent, shrub to 3 m., flowers white, calyx at length expanded and scarlet, dakama forest, bottom of Arrowhead Basin. 515 m., Tafelberg, *24618;* infrequent, shrub to 3 m. high, calyx orange, montane forest, between Camps 3 and 4, Coppename R. headwaters, *24161.* Throughout Guiana.

HEISTERIA IQUITENSIS Sleumer. BRITISH GUIANA: tree 40–50 ft. high, 8 inch. diam., calyx pink, mora and mixed forest, Kamuni Creek, Groete Creek, Essequibo R., *22914;* occasional, 4 m. tree, 3 cm. diam., calyx inflated, crimson, fruit white, from low bush by stream, Kaieteur savanna, *23389.* Amazonas, eastern Peru. New to British Guiana.

HEISTERIA DENSIFRONS Engl. BRITISH GUIANA: occasional, tree to 15 m. high, 15 cm. diam., flowers small, white, fruit and calyx orange; rocky lateritic soil from dolerite dyke, Garraway stream, Potaro R., *22980.* New to British Guiana; hitherto only known from Amazonian Brazil. I was able to compare the above with a duplicate type preserved in the Leiden herbarium.

HEISTERIA SCANDENS Ducke. SURINAM: rope; flowers white, in *24856;* mixed wallaba forest, hill south of camp 3, km. 10, Coppenam R. headwaters, *24859.* Amazonian district, Guiana. Apparently only in the interior of Surinam.

The following key may be offered for the *Heisteria* species of Guiana:

1. a. Vine, fruiting calyx reflexed; throughout Guiana. *H. scandens* Ducke.
2. a. Fruiting calyx surpassing the fruit, deeply 5-lobed, red, at last expanded, 4–5 cm. diam., sepals during flowering nearly free . . . 3.
   b. Fruiting calyx much shorter than the fruit, calyx during flowering shortly 5-dentate . . . 4.
3. a. Leaves oblong to lanceolate-oblong, 12–25 cm. × 3–7 cm., in sicco smooth beneath; throughout Guiana. *H. cauliflora* Sm.
   b. Leaves elliptical, 7–14 cm. × 3.7 cm., in sicco distinctly rugose beneath; British Guiana. *H. iquitensis* Sleum.
4. 3. Pedicels 5 mm. long, fruiting calyx with rounded lobes, at last expanded, 1–1½ cm. in diam.; Surinam. *H. surinamensis* Amsh.
   b. Flowers subsessile or very shortly pedicellate . . . 5.
5. a. Fruiting calyx developed as a 5-dentate short cup, enclosing the lower part of the fruit; British Guiana. *H. densifrons* Engl.
   b. Fruiting calyx developed as a narrow rim at the base of the fruit; French Guiana, Surinam. *H. microcalyx* Sagot.

BALANOPHORACEAE

HELOSIS CAYENNENSIS (Sw.) Spreng. BRITISH GUIANA: apparent saprophyte on leaf-mold, Potaro River Gorge, 1 mile below Kaieteur Falls, *23524.* Root parasite, or possibly saprophytic, dense rain-forests, Colombia, Venezuela to Martinique and Trinidad, and the Guianas, possibly also in Central America.

[43] By G. J. H. Amshoff.

POLYGONACEAE

Coccoloba conduplicata Maguire, sp. nov. Sect. *Campderia* Lindau. Frutex subscandens; ramulis siccitate fusco-cinereis, angulatis, puberulentibus, sparse punctatis, ochreis membranaceis, apicibus obliquis, obtuso-acutis; foliis lanceolatis, obtusis vel acutis, conduplicatis, venulis reticulatis, subtus sparse punctatis; racemis terminalibus, juvenalibus puberulentibus, sparse punctatis, nodis 1–3-floribus; perianthiis stipitatis, segmentis oblongo-obovatis, obtusis; fructibus biconicis vel bipyramidalibus, perianthii lobis accrescentibus.

Shrub 2–4 m. high, frequently weak or scandent, branches gray-brown, when dry angled, sparsely puberulent and punctate; ochrea membraneous, 3–5 mm. long, oblique, the apex obtuse to acutish; blades lanceolate, glabrous, entire, 3–7 cm. long, 1.2–3.0 cm. broad, becoming conduplicate at maturity or in drying, chartaceous, pinnately veined, with 3–5 pairs, prominently reticulate on both surfaces, more or less sparsely orange-glandular-punctate on the lower surface and on the 3–5 mm. long, puberulent petioles, the apex acutish; racemes 3–5 cm. long, terminal, the rachis striate in drying, puberulent and inconspicuously punctate, the nodes 1–3-flowered, bracts ca. 1 mm. long, triangular-ovate, obtuse, ciliolate; pedicels 1–2 mm. long, puberulent; flowers white, in anthesis 2–3 mm. long, the tube stipitate, nearly equaling the oblong-obovate, obtuse perianth segments; stamens 8–10, filaments slender, expanded from above the middle and connate toward the base, the anthers ca. 0.4 mm. long, 0.6 mm. wide, 4-lobed, versatile; styles 3; fruit 6–8 mm. long, broadly biconic or bipyramidal, the perianth lobes accrescent from above the middle, completely enclosing the matured ovary; seed reddish-brown, crustose, deeply 3-lobed, each lobe in turn deeply sulcate, saccate at the base, albumen copious, very white.

TYPE: shrub to 4 m. high, flowers white, fruit drying rust-colored, the single 6-lobed seed dark red-brown, frequent, open scrub-rock savannas, Savanna VIII, Tafelberg, Surinam, 776 m. altitude, August 22, 1944, *Maguire 24437*. Cotype: scandent vine, flowers white, frequent, Savanna II, Tafelberg, *Maguire 27205*. New York Botanical Garden.

Frequent and characteristic of rocky pygmy bush openings and the escarpment edge on Table Mountain. Known only from Tafelberg, *C. conduplicata* is at once recognized by its folded, chartaceous, reticulately-veined, punctate leaves. It holds this last character in common with *C.lepidota* A. C. Smith, and like it belongs to the section *Campderia* Lindau, but differing widely in habit, leaf form, and inflorescence.

COCCOLOBA GUIANENSIS Meissn. BRITISH GUIANA: liana 2–3 cm. diameter, in low tree in bush island, rare, Kaieteur Savanna, *23316;* scandent shrub, secondary mixed forest, fruit in terminal spikes, ovoid, purple-black, thinly fleshy, Mazaruni Station, *F1533*. British Guiana, the Guianas, and the Amazon Basin, Brazil.

COCCOLOBA MICROPUNCTA Eyma. SURINAM: rope with pink and white flowers, banks of Saramacca River above Kwatta hede, *23927; 23929*. Known previously only from the type, upper Surinam River near Goddo, *Stahel 77*.

TRIPLARIS SURINAMENSIS Cham. SURINAM: tree 25 m. tall, 30 cm. diameter, pistillate flowers greenish-white, the lobes becoming pink, frequent in openings, Toekoemoetoe Creek near confluence with Saramacca River, *24914;*

with data as in preceding but from a staminate tree, *24915*. Apparently not uncommon in rain-forests of the Guianas and Amazonian Brazil; poorly separated from specimens passing as *T. americana* L.

NYCTAGINACEAE

BOERHAAVEA COCCINEA Mill. *B. paniculata* Rich. SURINAM: weed in open sandy places, Charlesburg Rift, 3 km. north Paramaribo, *22741*. Widely distributed weed in tropical America.

NEEA CONSTRICTA Spruce ex Schmidt. BRITISH GUIANA: tree 40 feet high, 6 inches diameter, from ropy forest, leaves thinly fleshy, glabrous, all parts brittle, flowers in terminal inflorescence, pink, fleshy, Takutu Creek to Purini River, Mazaruni River, *F2140* ♀; tree 20 feet high, 4 inches diameter, flowers in terminal cymose inflorescence, pale creamy, easily detached, corolla magenta-colored, lobes small, stamens inserted at base of tube, in white sand, wallaba bush, 50 miles, Bartica-Potaro Road, *F1435* ♂.

This last is apparently the only staminate specimen of the species known. The pistillate specimens are satisfactorily similar to the isotype of *N. constricta*, in vicinibus Santarem, Pará, July 1850, *R. Spruce* sine no., at the New York Botanical Garden. Previously known only from the type collection. Possibly conspecific with *N. constrictoides* Heimerl from Bogotá, Colombia.

NEEA aff. *cauliflora* Heimerl. BRITISH GUIANA: tree 50 feet high, 12 inches diameter, fruit in cymose fascicles on the stem, globose, emarginate, fleshy, cotyledons ruminate, mixed forest, Groete Creek, Essequibo River, *F1747*. This collection is probably to be referred to *N. cauliflora* Heimerl, represented by *Ule 9365* and *9365b* from Amazonas. Neither authentically named specimens nor adequate descriptions are available which would make it possible to fix the Fanshawe specimens with more certainty.

PISONIA GLABRA Heimerl. SURINAM: tree 12 m. tall, 20 cm. in diameter, southwest escarpment, Tafelberg, *24628*. Fairly closely matching the isotype (*Sandwith 553*) of *P. glabra* from British Guiana, the above collection is perhaps best assigned to this species. In addition to our plant and the type collection, represented by *Jenman 3978*, Upper Demerara River, British Guiana.

PISONIA OLFERSIANA Link, Klotzsch & Otto. BRITISH GUIANA: tree 30 feet high, 4 inches diameter, wood streaky yellow, brittle, wallaba forest, Moraballi Creek, Essequibo River, *F268;* tree 25 feet tall, 3 inches diameter, stamens exserted, filaments white, Waini River, N. W. D., *F2338;* same locality, pistillate plant, *F2347*. SURINAM: infrequent tree, 15 m. high, flowers inconspicuous, green, fruit purple, primary jungle, Charlesburg Rift, 3 km. north Paramaribo, *22793;* border of savanna, vicinity Mata, Zanderij I, *24955*. Widespread in rain-forests, Venezuela and Trinidad to southern Brazil and Bolivia.

PISONIA SALICIFOLIA Hiemerl. BRITISH GUIANA: Demerara River, *Jenman 3899;* Lamaka Dam, *A. W. Bartlett* sine no.; Georgetown, *Hitchcock 16683;* tree 20–30 feet tall, 3 inches diameter, fringe *Euterpe* swamp, Mabaruma, Aruka River, N. W. D., *F2378*. Known from Trinidad and British Guiana.

PHYTOLACCACEAE

PHYTOLACCA RIVINOIDES Kunth & Bouché. BRITISH GUIANA: weed in old field, Bunsika Creek, Aruka River, *F2450*. SURINAM: rank herb, flowers

white-pink, rachis bright purple-red, openings in high bush, base of north escarpment, Tafelberg, *24307*. Widely distributed in tropical America from Mexico and the West Indies through the Amazon Basin and Peru.

PORTULACEAE

PORTULACA PILOSA (?) L. SURINAM: frequent annual, herbage red, flowers white, shallow open sandy soil, islands in rapids between Grasi Falls and Posoegronoe, Saramacca River, *23996*.

CARYOPHYLLACEAE

DRYMARIA CORDATA (L.) Willd. BRITISH GUIANA: weed, Mazaruni Forest Station, Mazaruni River, *23562*. A pan-tropical weed.

NYMPHAEACEAE

NYMPHAEA RUDGEANA G. F. W. Meyer. BRITISH GUIANA: flowers white, locally common, floating in Potaro River backwater above the falls, Kaieteur Plateau, *23405*. SURINAM: abundant, backwater, Saramacca River, Kwakoegron, *25004*. Widely distributed in the West Indies and tropical South America.

MENISPERMACEAE [44]

ABUTA BULLATA Moldenke. BRITISH GUIANA: Potaro River below Tukeit, base of the Kaieteur escarpment, *23489;* occasional, rope with stem diameter of 4 cm., leaves stiff, chartaceous, staminate flowers green, fruit yellow, *23505*. The species is known only from Amazonas, Brazil, and British Guiana. The type collection and the only other previously known collection from British Guiana are also from the basin of the Potaro River. The flowers of the species were not known up to the time of the present collections and so are described herewith: staminate inflorescence: bractlets linear, about 1.5 mm. long, densely pubescent with appressed forward-pointing plainly visible hair; prophylla 2, oblong, about 1.5 mm. long and 0.7 mm wide, very concave on the inner face, densely appressed-pilose on the back, acute at apex; sepals 6, the 3 outer ones oblong, about 2 mm. long and 1 mm. wide, fleshy, very concave on the inner face, subacute at apex, appressed-strigose with microscopic hairs on the outer face, the 3 inner ones ovate-suborbicular, fleshy, about 1.8 mm. long and 1.5 mm. wide, rounded at apex, concave on the inner face, appressed-strigose with microscopic hairs on the outer face; stamens 6, about 1 mm. long, glabrous.

ABUTA KLUGII Moldenke. BRITISH GUIANA: tough black rope from secondary white sand forest, leaves leathery, stiff, brittle, flowers in axillary spikes, yellow-green, mostly in bud, Sandhills, Demerara River *F1214* (3950). British Guiana through Amazonas, Brazil to Loreto, Peru.

ABUTA OBOVATA Diels. BRITISH GUIANA: grey hardish rope 4 cm. diam., leaves stiffly leathery, inflorescence axillary, fruit oblong-ovoid, yellow, glabrous, pericarp thinly fleshy, stone wrinkled, embedded in translucent pulp, from crown of Kakaralli, 107 mile Bartica Potaro Road, *F1497* (4233). British Guiana, Bolívar, Venezuela, and Amazonas, Brazil.

[44] By Harold N. Moldenke.

CHONDODENDRON CANDICANS (L. C. Rich.) Sandw. BRITISH GUIANA: rope from crown of *Talisia*, leaves glaucous below, fruit ovoid, green, mealy, endosperm white, Keriti Creek, Essequibo River, *F887* (3623). Known definitely only from British Guiana and Surinam; recorded from "Rio Acre, Peru."

CISSAMPELOS ANDROMORPHA P. DC. BRITISH GUIANA: woody vine, growing on a small tree in ropy forest, stem ½–1 cm. in diameter, leaves membranous, pruinose beneath, flowers cauliflorous, in delicate greenish fascicles of 2 or more together, male flowers greenish-white, petals erect-patent, disc whitish, cupular, stamens on an erect pedicel in center of flower, Takutu Creek to Puruni River, Mazaruni River basin, *F2066* (4802). The species is widespread in tropical America.

MYRISTICACEAE [45]

IRYANTHERA LANCIFOLIA Ducke. BRITISH GUIANA: tree 60 ft. high, 8 in. diam., from *Iryanthera* marsh forest, lvs. thinly leathery, supple, [staminate] flowers pale green, in short axillary spicate rusty-tomentose inflorescences, vernacular name *Kirikaua*, Kaituma River, 12 miles up, *F2410*. New to the Guianas. The cited specimen is referred with hesitation to a species previously known only from Amazonian Brazil and adjacent Peru, but the foliage and staminate inflorescences of our plant agree perfectly with those of material cited by me in Brittonia **2**: 449 (1938). The inflorescences are shorter than normal but are immature. A similar occurrence in the Northwest District of a typically Amazonian species of *Iryanthera* was noted in the case of *I. macrophylla* (Benth.) Warb. (op. cit. 430).

Possibly *F1272*, a sterile specimen from the Mazaruni Station, also represents *I. lancifolia*.

IRYANTHERA PARAENSIS Huber. BRITISH GUIANA: tree 50 ft. high, 6 in. diam., in mixed forest, vernacular name *Kirikaua*, Mazuruni Station, *F1384*. Known from a few other collections from British Guiana; also in Surinam, Amazonian Brazil, and adjacent Peru.

VIROLA SEBIFERA Aubl. BRITISH GUIANA: trees 30–60 ft. high, 2–10 in. diam., Mazaruni Station; *F534*; *F622*; Makauria Creek; *F581*; Forest Dept. *D398*. Widely distributed throughout tropical America.

VIROLA SURINAMENSIS (Rol.) Warb. SURINAM: frequently large tree to 40 m. high and 2 m. diam., buttresses spreading 6 m., pina swamp, km. 10.5, Coppenam River Headwaters, Surinam, *24853*. Locally abundant from the Lesser Antilles to the Guianas and eastern Brazil.

In 1889, Mez published the most recent revision of the Lauraceae of South America. Since that time no one had made an extensive study of the family of this hemisphere until Dr. A. F. G. H. Kostermans began publishing in 1936. Dr. Kostermans had at his disposal most of the types necessary and examined thoroughly the literature of the group. His treatment of the

[45] By A. C. Smith.
[46] By Caroline K. Allen.

Lauraceae in Pulle's Flora of Surinam served as a basis for the present preliminary report.

PERSEA BENTHAMIANA Meissner. BRITISH GUIANA: tree 21 m. high, 35 cm. diam., with low buttresses, bark and wood with odor of pine resin, leaves stiffly coriaceous, pruinose beneath, inflorescences axillary spikes, flowers pale cream, perianth pubescent, stamens, style and ovary pubescent, marsh forest of Sacoglottis, Pouteria and Iryanthera, Kaituma River 12 miles up, ***F2402*** (5138). Reported from the Guianas and Brazil. One of the two wild species of *Persea* in this area.

OCOTEA RHYNCOPHYLLA Mez. BRITISH GUIANA: tree 30 m. high, 20 cm. diam., clumped, wood resembling that of Yellow Silverballi, leaves thinly coriaceous, glaucous beneath, inflorescences axillary many-flowered panicles, flowers creamy yellow, Clump-Wallaba forest, 107 mile, Bartica-Potaro Road, ***F1514*** (4250). Described from Brazil.

The inflorescences of the type-specimen are shorter, fewer-flowered than those of the number cited above, some of the branchlets of which seem to have suffered damage, perhaps from galls.

OCOTEA GUIANENSIS Aublet. BRITISH GUIANA: tree 18 m. high, 30 cm. diam., leaves chartaceous, silvery sericeous beneath, young fruit gray-green in axillary spikes, mature fruit in spikes below leaves, cupule greenish-brown, verruculose, shallow, hemispheric, fruit oblong, green, not quite ripe, "Kereti," secondary Kokerite forest on light brown sand, Ituni Road, Mackenzie, Demerara River, ***F2483*** (5219). Known from Guiana and Brazil. One of the most spectacular of the Lauraceae of this area, because of the bright sericeous under-leaf surface.

OCOTEA GUIANENSIS Aublet var. SUBSERICEA Kostermans. BRITISH GUIANA: tree to 27 m. high, 50 cm. diam., bark faintly aromatic, leaves coriaceous, rugose beneath, sericeous when young, indument indistinctly subsericeous in maturity, young fruit green, in panicles, cupules rugulose, "White Silverballi," Kautaballi forest, Ituni Road, Mackenzie, Demerara River, ***F2478*** (5214). Described by Kostermans from Surinam. The young fruits are almost entirely enclosed by the surrounding cupule, which brings to mind the characteristic fruits of the genus Aniba.

OCOTEA GLOBIFERA Mez. BRITISH GUIANA: tree 21 m. to 30 m. high, 20–25 cm. diam., trunk unbuttressed, but basally swollen, adult branchlets glabrous, grayish, leaves thickly chartaceous to leathery, elliptic to obovate, inflorescences terminal or axillary, spicate, aromatic, pistillate flowers pale cream, fruit globose, glossy, dark green, cupule black-brown, verruculose, "Pear-leaf Silverballi," "Shirua," mixed forest, on brown sand, possibly a secondary species, Mazaruni Station, ***F767*** (3503), ***F1363*** (4099). Heretofore reported only from French Guiana.

The specimens cited above bear soft, fine, subsericeous instead of sparse ferruginous pilose pubescence beneath on the midrib. Mez relates the species to *O. commutata.*

OCOTEA CANALICULATA (Richard) Mez. BRITISH GUIANA: tree large, 33 m. high, 40 cm. diam., unbuttressed, bark faintly scented, branchlets gray or ferruginous-tomentose, leaves oblong or elliptic-lanceolate to 14 cm. long, coriaceous, densely but sometimes obscurely areolate, glaucous beneath, inflorescences numerous, axillary, narrowly paniculate, branched, ferruginous-

tomentellous, branchlets pink, usually (see Kostermans) not more than 9 cm. long, but in the specimen cited below up to 15 cm., flowers and buds appearing bronze-green, perianth lobes pink, erect to spreading, "White Silverballi," "Hariraru," secondary Kautaballi forest, Mazaruni Station, *F651* (3387). Reported from Guiana, Trinidad and Northern Brazil.

The inflorescences are much shorter, and the flowers are pink rather than yellow. Otherwise the specimen cited matches the fragment of the type from Cayenne.

OCOTEA ? CARACASANA (Nees) Mez. BRITISH GUIANA: tree 25 m. high, 30 cm. diam., with low buttresses, branchlets ferruginous-tomentellous, becoming glabrous, brownish, angled, leaf-blade large (to 24 cm. long), coriaceous, brownish sericeous beneath decurrent and inrolled at the base up to 2 cm., above coarsely and somewhat prominently reticulate, shining, inflorescences numerous, pyramidal, equalling or shorter than leaves, tomentellous, flowers densely tomentellous, creamy, the lobes somewhat keeled, ovary pale green, Mora forest, siding a swamp, Mazaruni Station, "Baradan," *F631* (3367). Described from Venezuela.

The specimen cited above differs from the type and from supposedly authentic material from Venezuela, in having somewhat larger leaves with definitely brown-sericeous lower surface, instead of the ferruginous pubescence giving way later to a subglaucous condition. The inflorescences too are more brownish than ferruginous. If Fanshawe's number is not *O. caracasana,* its alliance is certainly with that species or group of species.

OCOTEA cf. *O. glomerata* (Nees) Benth. & Hook. BRITISH GUIANA: tree 18–30 m. high, 30–40 cm. diam., buttressed to 1.3 m., leaves glaucous beneath, rugose, coriaceous, inflorescences axillary, shortly branched, flower buds creamy-green, flowers withered, probably milk-white, outer surface of perianth, calyx-tube and flower spike pubescent, young fruit green, pubescent, oblong, crowned by withered flower, mature fruit purple-black, cupule brownish, mixed forest on brown sand, Turu bush, Moraballi Creek, Essequibo River, and Mazaruni Station, "Kurahara Silverballi," *F1306* (4042) and *F1979* (4715).

OCOTEA OBLONGA Mez. BRITISH GUIANA: tree 9–18 m. high and 15–20 cm. diam., leaves coriaceous, glossy, inflorescences paniculate, flowers downy, drooping when open, young fruit green, ovoid, glossy, young cupules obovate, 5-ribbed, green, narrowing into pedicel, mature cupule obconical, with small rim, brown-green, verruculose, mature fruit pale green, light-verruculose, seed whitish, forest near river bank, *F729* (3465); secondary mixed forest, Mazaruni Station, "Keriti," *F926* (3662). Known from French Guiana, also, and one collection reported by Mez from Trinidad; a single number of the Bang collection from Bolivia is noted as probably being this species.

The inflorescences of the above numbers seem to be more strict than pyramidate-paniculate as described by Mez and appear longer than the leaves. Possibly they do not belong to this species.

OCOTEA ? LAXIFLORA Mez. BRITISH GUIANA: shrub or small riparian tree to 6 m. high, 7.5 cm. diam., leaves thinly coriaceous, glabrous, shining above, long-acuminate to acuminate-caudate, elliptic, staminate inflorescences axillary, rather few-flowered, usually unilateral, flowers white, fragrant, Waini River by Big Kunali Creek, N. W. D., *F2333* (5069). Reported from Bra-

zilian Amazon, Venezuela, and Bolivia. Mez describes the flowers as yellow. The venation of the leaves from the type-material is more arcuate and less ascending.

OCOTEA ABBREVIATA Schwacke & Mez. SURINAM: small tree (low shrub, according to Schwacke & Mez), bark used as spice, leaves chartaceous, glabrous, olive-green and shining above, prominently reticulate throughout, margins recurved, staminate inflorescences short, few-flowered, flowers white, islands in rapids along river between Grasi Falls and Posoegronoe, Saramacca River, *24000;* pistillate inflorescences short, flowers whitish, fruit immature, primary jungle, near Posoegronoe, Saramacca River, *24018.* Described originally from the province of Rio de Janeiro, eastern Brazil.

Both localities have in common the low altitudes along the shore and rivers. Schwacke & Mez describe the bark of this tree as slightly aromatic, astringently and minutely stinging.

OCOTEA CAUDATA (Nees) Mez. BRITISH GUIANA: undergrowth shrub or small tree to 7–8 m. high, 5 cm. diam., branchlets reflexed, buds green, flowers yellow or pink, in delicate axillary cymes, fruit oblong, green, cupule smooth, shining, crimson, pedicel crimson, much thickened, "Yellow Silverballi," "Yekuru," high secondary mixed forest, Kartabo Road, Mazaruni Cuquin District, *C. W. Anderson 48 A;* Mazaruni Station, *F503* (3239); Kamuni Creek, Groete Creek, Essequibo River, *22903.* Reported from British Guiana, Northern Brazil and possibly Bolivia.

Kostermans (Meded. Bot. Mus. Utrecht **25**: 16. 1936) mentions that possibly *O. urophylla* (Meissner) Mez is a variety of the above species. He also includes *O. marowynensis* Mez as a synonym. I suggest, also, that *O. punctulata* should be considered carefully as possibly conspecific. The latter species was described from fruiting material alone, collected in French Guiana. *O. caudata* and *O. urophylla* were collected in British Guiana and represent staminate and pistillate flowers respectively. *O. marowynensis* was described from a staminate flowering specimen of Surinam. In species with dioecious flowers, it is very difficult to state definitely that the different phases are conspecific, since there is usually a great deal of variation in this section of the genus.

OCOTEA NEESIANA (Miquel) Kostermans. SURINAM: small tree to 15 m. high, branchlets blackish, glabrous, leaves membranaceous to chartaceous, glabrous and more or less shining, apex long-acuminate, inflorescences short, somewhat branched, comparatively long-pedunculate, staminate flowers almost glabrous, sandy soil of old sea beach consisting of open scrub land, primary jungle bordered on both sides by swamps and marshes, Charlesburg Rift, 3 km. north of Paramaribo, Saramacca River, *22794.* Heretofore known only from Brazil. The flowers are reported to be yellow.

OCOTEA PUBERULA Nees. BRITISH GUIANA: tree (or shrub, fide Mez) 6–27 m. high, 5–40 cm. diam., bark and wood faintly aromatic, leaves chartaceous or subcoriaceous, reticulate, staminate inflorescences axillary, slender, paniculate, up to 8.5 cm. long, flowers pale yellow, pistillate inflorescences axillary and terminal, not longer than 2.5 cm. long, flowers whitish, young fruit ovoid, green, becoming globose, glossy, dark green with lighter dots, subtended by a green cupule, in part flushed red, like pedicels, "Shirua," river bank forest, sand hills, Demerara River, *F1231* (3967); "Keriti," Mazaruni Station, *F1277* (4013); secondary forest on lateritic

gravelly soil, Mabaruma, Aruka River, N. W. D., *F2428* (5164). Reported throughout tropical South America as far south as Argentina. Kostermans includes *O. Martiniana* Mez in the above species.

Ocotea Schomburgkiana Mez. British Guiana: tree to 24 m. (shrub to 2 or 3 m. high, according to Mez), leaves elliptic to broadly elliptic, coriaceous, loosely reticulate and shining above, more densely reticulate beneath, inflorescences axillary, sometimes up to 10 cm. long, usually less, staminate densely flowered, pistillate less so, flowers creamy white, very fragrant, fruit ovoid, acute, one-third covered by hemispheric, simple and entire-margined cupule, Wallaba forest, sand hills, Demerara River, *F906* (3642).

Ocotea glaucina (Meissner) Mez. Surinam: tree to 18 m. high, 15 cm. diam., branchlets glabrous, somewhat slender, dark, leaves chartaceous-coriaceous, shining above, densely and prominently reticulate throughout, elliptic, acuminate or acute, about 12 cm. long, steep east-facing slopes, high forest, altitude 300 m., south of East Ridge, Tafelberg, *24548*. Described from Brazil.

The specimen cited above, although in fruit, matches very well the *Blanchet 3577* cited both by Mez and Meissner. The chief difference appears to be the more rounded leaf-base of the Brazilian specimen, and the less glaucous aspect of the lower-leaf surface of the Guiana collection. Both numbers show a peculiar phenomenon in that the tips of the uppermost (younger) leaves in each case are without reticulation on their upper half, more so on the upper surface than on the lower. This may have been occasioned by the specimens being placed too near the heat in drying or it may be due to a physiological factor inherent in the species.

Nectandra grandis (Mez) Kostermans. British Guiana: large tree up 30 m. high, 20 cm. diam., branchlets stout, angled, ochraceous-tomentellous, leaves shining above, glaucous beneath, midribs pale orange-brown, staminate flower buds ovate, mealy, gray, narrowed above center, corolla lobes pale or creamy yellow, anthers green, ovary yellow-orange, narrowed just below lobes, softly pubescent, Moraballi Creek, Essequibo River, altitude 60 m., "Buradié," *F130* (2739). Reported from French Guiana and British Guiana and questionably from Brazil by Kostermans. This striking tree is one of the two dioecious species of *Nectandra* reported from this region.

Nectandra Pisi Miquel. British Guiana: tree 3–12 m. high, 20–30 cm. diam., bark faintly aromatic, leaves rigidly coriaceous, margin incurved at base, somewhat shining above, puberulous to glabrescent beneath, often barbellate in axils, inflorescences terminal or axillary corymbose panicles, milk-white, perianth lobes almost woolly-tomentose, outer greenish, fruit ovoid, green, glabrous, cupule red, verruculose, "Shirua," "Yellow Silverballi," Bonasika Creek, Essequibo River, *C.W. Anderson 86;* Supenaam River, For. Dept. Brit. Guiana *999* (B 3); secondary mixed forest on loam, Groete Creek, Lower Essequibo River, *F1257* (3993); by creek-side, Sabaina Creek, Morebo Creek, Waini River, N. W. D., *F2350* (5086); leaning over Sebai Creek, Kaituma River, *F2422* (5158). Found in Guiana, in the Amazonian District. Kostermans (Meded. Bot. Mus. Utrecht **25**: 19. 1936) has segregated this species from Mez' *N. globosa* which is not known in Guiana.

Nectandra Maguireana Allen, nom. nov. *Nectandra amplifolia* Rusby, Descr. N. Sp. S. Am. Pl. 20. 1920, non Mez. Surinam: tree to 25 m. high,

50 cm. diam., branchlets somewhat slender, pale ferruginous-tomentellous, becoming glabrous, leaves chartaceous, nerves and midrib prominent beneath, axils glandular, pubescent, inflorescence grayish tomentellous, flowers large, white, fragrant, Toekoemoetoe Creek, Saramacca River, *24071;* opening by Grace Falls, base of south escarpment, Arrowhead Basin, altitude 625 m., *24490;* high mixed forest, base of cliffs, west escarpment, altitude 420 m., *24688.* Described by Rusby from Santa Marta, Colombia, at an altitude of 1100 m.

There is a close relationship between this species and *N. Pisi* for the most part commonly known as *N. globosa* (see Kostermans in Meded. Bot. Mus. Utrecht **25**: 24. 1936), differing from the latter in the texture of the leaves and the presence of pubescence on the style.

NECTANDRA CUSPIDATA Nees. BRITISH GUIANA: tree to 30 m. high, 30 cm. diam., branchlets minutely ferruginous-brown tomentose presently becoming grayish, leaves coriaceous, lanceolate-acuminate, nerves ascendent, inflorescences full-flowered, spreading, panicles longer than leaves, fruits ellipsoid, green, becoming black, subtended by shallow cupule, secondary forest on loose brown sand, Mazaruni Station, "Shirua," *F713* (3449); "Silverballi called Keriti," Issororo Station, Aruka, For. Dept. Brit. Guiana *388.* Probably common throughout northern part of South America.

Mez included this species under *N. Pichurim,* which may be distinguished by the hemispheric cupule and the more numerous nerves of the leaves (see Kostermans, Meded. Bot Mus. Utrecht **25**: 21. 1936). There has been associated with these two entities the species *N. amazonum,* which bears flowers nearly twice as broad in diameter, and whose anthers are provided with well-defined connectives, and *N. urophylla,* also with larger flowers. *N. ambigua* as well, suggested by Kostermans as a possible variety of *N. Pichurim,* appears to have larger flowers than the species proper.

NECTANDRA LUCIDA Nees. BRITISH GUIANA: tree 12 m. high, 15 cm. diam., leaves thinly coriaceous, glabrous, finely reticulate, inflorescences axillary, up to 15 cm. long, peduncle up to 10 cm. long, flowers including anthers white, Takutu Creek to Puruni River, Mazaruni River, *F2089* (4825). Described from Guiana and the Alto Amazon region. The Fanshawe number is a match for the type of *N. Schomburgkii* which Mez has reduced under *N. lucida.*

ANIBA KAPPLERI Mez. SURINAM: tree to 13 m. high, 10 cm. diam., branchlets glabrous, covered with numerous small lenticels, leaves alternate, chartaceous or thinly chartaceous, glabrous, dull, inflorescences subterminal panicles, many flowered, ferruginous-tomentellous, flowers cream, rear of village, Jacob kondre, Saramacca River, *23887.* Known from Dutch and British Guiana.

The branchlets are rather more brownish than gray and the flowers are cream-colored rather than white or dull golden-yellow, as mentioned by Kostermans. The petioles seem to be heavily verruculose (owing perhaps to the presence of numerous lenticels?), a fact not mentioned by Kostermans.

ANIBA ROSAEODORA Ducke. BRITISH GUIANA: tree to 4 m. high, 4 cm. diam., buds golden, young branchlets rufo-ferruginous becoming fuscescent-tomentellous, leaves rigid-coriaceous, beneath pulverulent-tomentellous, yellowish to ferruginous-orange, inflorescences many-flowered, paniculate, fer-

ruginous-tomentellous, river side above Kaieteur Falls, Kaieteur Plateau, *23374*. Reported from the Amazon Basin, the Guianas, and Colombia.

The tree, according to Kostermans, reaches a height of 30 m. and is seemingly very common; whereas the number cited above is pronounced rare and not more than 4 m. high. The collectors do not mention the presence of an essential oil which is distilled from the species and used commercially. However, the specimen under discussion matches the species as it is understood by the author.

ANIBA EXCELSA Kostermans. BRITISH GUIANA: tree 18 m. high (to 35 m. fide Kostermans), 30 cm. diam., bark and wood sweetly aromatic, branchlets robust, rugose, densely ferruginous-tomentellous becoming grayish, glabrescent, buds densely ferruginous-velutinous, with large scales, leaves thick, coriaceous, ferruginous-tomentose beneath, blade decurrent on stout petiole, inflorescences terminal, ferruginous-tomentose, with greenish-cream tomentose flowers barely opening, mixed forest, "Greenheart Gale," Mazaruni Station, *F1362*. Known only from British Guiana.

Kostermans describes the inflorescences as being not more than 13 cm. long. The number cited above seems to agree with the original description in all but the length of the inflorescences, which is nearly 20 cm. The leaves of Maguire's collection are up to 10 cm. in width.

ANIBA HOSTMANNIANA (Nees). SURINAM: small tree or shrub, to 4 m., branchlets stout, sulcate, ferruginous-tomentellous, becoming glabrescent, with conspicuous lenticels, leaves subverticillate, coriaceous or rigidly coriaceous, inflorescences paniculate, subterminal, many-flowered, up to 25 cm. in length, flowers cream-colored, petals not expanding in anthesis, infrequent on river banks below rapids, Jacob kondre, Saramacca River, *23822, 23823*. Known from Surinam and the lower Amazon Basin.

ANIBA CANELILLA (H.B.K.) Mez. BRITISH GUIANA: tree (or shrub, rare, according to Kostermans) 30–33 m. high, 75 cm. diam., bark, wood and leaves all having strongly scented essential oil rather like cinnamon, branchlets slender, glabrous, gray, leaves chartaceous, elliptic-lanceolate, lanceolate or subobovate-lanceolate (according to Kostermans), inflorescences paniculate, few-flowered, short, flowers greenish white (yellowish-tomentellous, according to Kostermans), growing in high miscellaneous forest on steep slope, with reddish loamy sand soil, southern side of Kanuku Mts., right bank of Rupununi River near Sand Creek, altitude 330 m., "Ashmud", For. Dept. Brit. Guiana *2251* (D260). Known from the Amazonian District and from Venezuela and also in cultivation.

The flowers of the cited specimen are greenish white and the outer perianth-lobes are shorter than the inner, which is characteristic of the species.

ANIBA cf. *A. salicifolia* (Nees) Mez. BRITISH GUIANA: tree to 17 m. high, 40 cm. diam., bark sweet-scented (but not as strongly as that of *A. Kappleri*, according to the collector), branchlets slender, reddish-brown or gray, cylindrical, with conspicuous lenticels, leaves subverticillate or alternate, chartaceous, inflorescences numerous, axillary and terminal, or subterminal, cymose-paniculate, flowers pale green, with downy flattened pedicels, fruit glaucous-green, purple when ripe, cupule hemispherical (subrotund), smooth, and according to Kostermans with rather large ferruginous wart-like spots, "Silverballi," flat light brown sandy areas with Aimoradan dominant, Mazaruni Station, *F726* (3462). Reported from the Amazon Basin

as well as the type-locality in French Guiana. The panicles of the cited specimen are more full-flowered than reported for the species. Possibly *A. trinitalis* (Meissner) Mez.

AIOUEA DEMERARENSIS Kostermans. BRITISH GUIANA: tree 9 m. high, to 15 cm. diam., basally swollen, bark faintly aromatic, young branches verticillate, branchlets gummy, leaves stiffly coriaceous but brittle, shining and smooth above, beneath opaque and prominulous-reticulate, inflorescences terminal, branchlets crimson, many-flowered, flowers small, greenish-yellow, secondary Dimorphandra Davisii forest, Bartica-Potaro Road, 107 mile, *F1439* (4175); Wallaba forest, Ituni Road, Mackenzie, Demarara River, *F2480* (5216). Reported only from British Guiana, and said to be used for gargling against sore throat.

LICARIA CAYENNENSIS (Meissner) Kostermans. *Acrodiclidium cayennense* (Meissner) Mez. BRITISH GUIANA: tree 12–24 m. high, 17–35 cm. diam., bark strongly aromatic, leaves thinly coriaceous, glabrous, flowers in short erect axillary or subterminal panicles, ferruginous-tomentellous, "Waibama," Greenheart forest, on brown sand, Moraballi Creek, Essequibo River, *F1290* (4026). SURINAM: between North Ridge and Augustus Creeks, altitude 570 m., Tafelberg, *24725*. Reported only from the Guianas.

Fanshawe describes the buds as pale green with a faintly rusty pubescence; Kostermans gives them as glabrous. Meissner's type of *Aydendron cayennense* is in fruit, and the leaves are somewhat more coriaceous, as is frequently found to be the case of fruiting specimens in other species. Otherwise the specimens cited agree.

LICARIA CANELLA (Meissner) Kostermans. BRITISH GUIANA: tree up to 35 m. high, 60 cm. diam., bark fairly smooth, silvery-grayish, leaves coriaceous, glabrous, shining on both surfaces, margins thickened and frequently noticeably inrolled near base, particularly in dried material, flowers greenish-cream, covered with ferruginous tomentum, fruit green, supported by a dull green cupule with brown corky warts, "Silverballi," Bonasika Reserve, Essequibo County, *C. W. Anderson 381;* on light brown sand, miscellaneous forest, altitude 15 m., Mazaruni Station, For. Dept. *2299* (D 308). Reported from Trinidad, the Guianas, and Rio Negro, Brazil.

LICARIA cf. *L. oppositifolia* (Nees) Kostermans. BRITISH GUIANA: tree (or shrub) to 6 m. high, 15 cm. diam., with slightly aromatic bark, branchlets straight, angular, ferruginous-tomentellous, becoming less so with age, apex caudate-acuminate, inflorescence short, axillary, golden-sericeous, flowers, according to the collector, scarcely opening, fruit oval, dull black, thinly fleshy, cupule hemispheric, red, rugulose, secondary forest on rubber estate, Mabaruma, Aruka River, N. W. D., *F2390* (5126). Reported only from British Guiana.

The leaves of the type are rounded at the base (although the description reads shortly acute as well) and are said to be ovate or ovate-lanceolate. The flowers of the Fanshawe number usually have six abortive stamens or staminodia which are very small, hairy and scale-like. The nearest alliance, however, is seemingly with the above species.

LICARIA cf. *L. multiflora* Kostermans. BRITISH GUIANA: tree 30 m. high, 60 cm. diam., buttressed to 4.5 m., branchlets densely but minutely ferruginous-tomentellous, becoming grayish, leaves chartaceous, inflorescence axillary, paniculate, ferruginous-tomentellous, many-flowered, up to 10 cm.

long, flowers minute, creamy, "Ginger Gale," mixed forest on a high ridge, Takutu Creek to Puruni River, Mazaruni River, *F2095* (4831). Described from the Rio Acre region of Brazil.

The inflorescence of the specimen from Guiana is not as full-flowered as that of the type. The leaves of the latter are, on the whole, smaller and perhaps more shining on the upper surface. The flower structure of both is similar, the stamens of the type being exserted to a greater degree than those of the Fanshawe number.

Licaria Maguireana Allen, sp. nov. Arbor 24 m. alta, cortice rubro-brunneo papyraceo, ramulis robustis rugosis. Folia verticillata, supra glabra, subtus pubescentia mox glabrescentia, petiolis 1 cm. vel minus longis ad 7 mm. diam., robustis turgidis, laminis crasse chartaceis longe obovatis, basin longo-attenuatis, 60 cm. longis et 16 cm. latis, basi cordatis vel subcordatis, apice obtusis vel obtuse breviterque acuminatis, penninerviis, costa supra satis elevatis conspicuisque, subtus crassissimis, nervis 10–24 paribus laminae basi patentibus ad apicem marginibus arcuantibus utrinque elevatis. Inflorescentiae numerosae subterminales multiflorae strictae racemoso-spicatae, 17–30 cm. longae ad 4 cm. latae. Flores longo-pedicellati, pedicellis 4–7 mm. longis, tenuibus, perianthio suburceolato, viridi, fide coll., lobis squamosis suborbicularibus, staminodiis exterioribus 9, tenuibus oblongis subligulatis pubescentibus, staminibus fertilibus 3, plus minusve seriebus exterioribus duplo longioribus, antheris subauricularibus, filamentis crassis pubescentibus, partem $\frac{2}{3}$ aequantibus, loculis apicale extrorsis, connectivo leviter exserto breve obtuso pubescente, staminodiis anguste triangularibus, seriebus exterioribus leviter longioribus, attenuate acutis pubescentibus, ovario obovoideo-ellipsoideo glabro, stylo plus minusve ovarium aequante glabro, stigmate truncato inconspicuo. Fructus, fide coll., ovoideus, viridis, nitidus.

TYPE: Greenheart bush on brown sand, Mazaruni Station, British Guiana, *Fanshawe 220* (F. D. 2956). New York Botanical Garden. Yaruru-Wamara forest, on light brown sand, Ituni Road, Mackenzie, Demerara River, British Guiana, *F2485* (5221).

The nearest alliance of this species seems to be *L. Mahuba* (Sampaio) Kostermans [Meded. Bot. Mus. Utrecht **46**: 123. 1938 (Rec. Trav. Bot. Néerl. **35**: 123. 1938)] from the flooded forests of Pará, Brazil. It differs from the Brazilian species, however, in having no tiny glands at the base of the three fertile stamens, a more strict inflorescence, more fully flowered, with long-pedicellate flowers in short racemules, and a cordate leaf-base. There is also a resemblance vegetatively to the genus *Mezilaurus*, which is borne out by the absence of glands in the latter genus.

ENDLICHERIA PYRIFORMIS (Nees) Mez. SURINAM: slender shrub (to large tree 30 m. high), branchlets slender with long internodes, smooth, shining, glabrous, pale green, leaf-blades thinly chartaceous, glabrous, shining green, slightly decurrent on slender petioles, inflorescences axillary, paniculate, few-flowered, flowers white, rare, overhanging stream, high forest, East Ridge Creek Gorge, Tafelberg, altitude 750 m., *24538*. Reported from the Amazon Basin and the Guianas.

ENDLICHERIA SERICEA Nees. SURINAM: tree 10–20 m. high, 50 cm. diam., wood "slippery," branchlets stout, striate, densely minutely yellowish subsericeous beneath, inflorescences paniculate, axillary or subterminal, densely minutely subsericeous, yellowish or brownish, many-flowered, frequent in

diabasic soil, mixed high forest, hill No. 1, 5 km. n. e. Savanna II, Tafelberg, altitude 555 m., *24712*. Known from the West Indies, the Guianas and vicinity.

The species is striking because of the golden satiny pubescence on the lower surface of the leaves and the prominence of the lower pairs of nerves, simulating a 3-nerved condition.

ENDLICHERIA ENDLICHERIOPSIS (Mez) Kostermans. SURINAM: tree, branchlets thick, angular, densely ferruginous-velutinous-tomentellous, leaves chartaceous or rigidly chartaceous, elliptic, adult brownish above dull, glabrous, beneath ferruginous-pubescent, inflorescences axillary, paniculate, pyramidal, ferruginous-tomentose, Toekoemoetoe Creek, Saramacca River, *24898a*. Reported by Kostermans from both French and Dutch Guiana. The pistillate specimen cited above appears to answer the description of the species.

CASSYTHA FILIFORMIS Jacquin. BRITISH GUIANA: parasitic leafless climber, stems yellow-brown, flowers white, occasional, trailing along ground in grassy open place, Kaieteur savannas, *23314*. SURINAM: frequent, Sanderij, Savanna II, *23700;* Sanderij I, *23726;* south savannas, Arawak village of Mata, *24966;* Savanna I, altitude 560 m., Tafelberg, *24399*. Pantropic.

Doubtful species of the collection.

Infrequent, south cliffs, Arrowhead Basin, Tafelberg, Surinam, *24472*. *Ocotea* or *Nectandra*. The flower structure of the specimen *24472* more nearly resembles that of a *Nectandra*. Occasionally, however, there are aberrant *Ocotea* specimens which bear anther-sacs approximating the arrangement common in *Nectandra*. If the specimen be an *Ocotea*, it is an hermophroditic species.

High forest, base south cliffs, Arrowhead Basin, Tafelberg, Surinam, *24472B*. A fruiting specimen of *24472*.

Shrub 4.5 m. high, leaves leathery, glossy, flowers in terminal or axillary cymose panicles, creamy, calyx pale green, second growth by roadside on lateritic ironstone soil, Mahdia Creek, Potaro River, Bartica-Potaro Road, British Guiana, *F741* (3477), "Yekuru." *Ocotea?* hermaphroditic specimen. Mounted on the same sheet with this number in the herbarium of the New York Botanical Garden is a small branchlet of a species which appears to be a part of *F906* (3642), *Ocotea Schomburgkiana*.

Tree 12 m. high, 15 cm. diam., leaves leathery, pubescent beneath, flowers in axillary inflorescences, whitish, buds gray, velvety, fruit oblong, smooth, green, cupule brown, woody, opening flat, mixed bush on brown sand by river, Madray Landing, Essequibo River, British Guiana, *F1702* (4438), "Shirua." Presumably the same as the following Fanshawe number.

Tree 21 m. high, 15 cm. diam., slightly buttressed, leaves thinly leathery, pilose beneath, appearing velvety, flowers in large, terminal, lax inflorescences, palest cream, perianth-lobes spreading, stamens introrse, ropey bush on brown sand, Madray-Bubu trail, Essequibo-Demerara, British Guiana, *F1683* (4419), "Shirua." Probably on *Ocotea,* and more nearly related to *O. commutata*. This number and the preceding one collected at nearly the same locality two days later, although showing a difference in the inflorescence, seemingly, are very likely the same species. Number 4438 shows a more fully developed inflorescence.

The following numbers I have not been able to determine satisfactorily.

The most of them are in fruit, and difficult to match since many of the species concerned have been described from flowering material alone.

Tree 9 m. high, 10 cm. diam., bark faintly aromatic, leaves stiffly chartaceous, sericeous beneath, fruit (not seen) axillary, one or more terminal on a common peduncle, cupule hemispheric, red, rugulose, secondary forest on rubber estate, Mabaruma, Aruka River, N. W. D. British Guiana, *F2387* (5123). Possibly *Aniba* or *Ocotea?*

Small tree to 3 m. high, bark aromatic, leaves large leathery, fruit long-stalked, supra-axillary, solitary, cupule dark brown, warty, fruit white, Kakaralli-Clump Wallaba forest, altitude 107 m., Bartica-Potaro Road, British Guiana, *F1449* (4185). Possibly *Aniba* or *Ocotea?*

Overhanging west escarpment, altitude 510 m., Tafelberg, Surinam, *24675.* Possibly *Aniba* or *Ocotea?*

High mixed wallaba forest, km. 25, altitude 210 m., Tafelberg, Surinam, *24825.* Possibly *Aniba* or *Ocotea?*

Diabasic soil, mixed high forest, hill No. 1, altitude 540 m., Tafelberg, Surinam, *24710.* Possibly *Aniba* or *Ocotea?*

Tree 3 m. high, 5 cm. diam., young fruit green, oval, glossy, cupule scarlet, occasional, Potaro River below Tukeit, Potaro River Gorge, British Guiana, *23481. Nectandra* or possibly *Ocotea?*

Between North Ridge and Augustus Creeks, hill No. 1, altitude 570 m., Tafelberg, Surinam, *24726. Ocotea?*

Tree 24 m. high, 40 cm. diam., buttressed to 1.3 m. from ground, leaves thickly chartaceous, glabrous, fruit stalked on cauliflorous inflorescence below leaves, globose, purple-black, glossy, thinly fleshy, cupule small, flat, thick, attached to base of fruit, seed brown, globose, faintly pointed, pulp greenish, creamy, mixed forest on lateritic soil, White Creek, Groete Creek, Essequibo River, British Guiana, *F1772* (4508), "Keriti." *Ocotea?* The rather large globose fruit borne below the leaves should very quickly place this species, but I have not been able to match it as yet.

Tree 12 m. high, 20 cm. diam., with strong, aromatic bark, resembling *Aniba ovalifolia*, leaves soft hairy, petioles of young leaves orange, old fruit-cupules black-brown, velvety, rugose, from Kakaralli-Clump Wallaba forest, 107 mile, Bartica-Potaro Road, British Guiana, *F1501* (4327). *Endlicheria?*

Tree 10 m. high, 12 cm. diam., fruit with enlarged pedicels, high forest, base south escarpment, Arrowhead Basin, Tafelberg, Surinam, *24488. Persea?*

Frequent tree to 10 m. high, 12 cm. diam., precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, Surinam, *24550. Persea?* Same as *24488?*

ROSACEAE[47]

The four genera reported upon herein all belong to the subfamily *Chrysobalanoideae.* No general review, aside from Kleinhoonte's[48] studies of Surinam species, has been made of any of the genera of the subfamily since Fritsch's[49] "Beitrage Zur Kenntries der Chrysobalanaceen." The present

[47] By D. B. Fanshawe & Bassett Maguire.

[48] Rec. Trav. Bot. Néerl. 22: 380–391. 1925; 30: 180–182. 1933; Fl. Suriname 2: 426–456. 1939.

[49] Ann. Naturh. Hofmus. 4: 33–60. 1889.

report deals with 44 species of which 5 apparently represent range extensions of consideration, and 11 are offered as new. We wish to express appreciation for the helpful criticism given us by Mr. N. G. Sandwith during the preparation of this report on Guiana Rosaceae.

Licania albiflora Fanshawe & Maguire, sp. nov. Arbor mediocris; ramulis crassis, griseo-fuscis, puberulentibus, foliis elliptico-oblongis vel obovatis, abrupte acuminatis, basibus obtusis, supra glabris, venis inconspicue impressis, inconspicuissime reticulatis, subtus subtile griseo-tomentosis, venis prominentibus, valde reticulatis, petiolis crassis, brevi-villosis, stipulis non visis; inflorescentibus paniculatis, pallidis fulvo-villosis, bracteis late ovatis, fere trilobatus, lobis acutis, tubis calycibus brevibus, lobis longius, ovato-triangularibus, acutis, patentibus, interioribus albo-pilosis, tubis interioribus dense lanato-pilosis; fructibus non visis.

Tree at least 25 m. tall and 30 cm. diam, branchlets coarse, grayish-brown puberulent; leaf blades broadly elliptic-oblong or obovate, abruptly acuminate at the apex, rounded at the base, primary veins 8–10 pairs, slightly impressed in the feebly reticulate and glabrous upper surface, prominent beneath, the strong secondary veins transversely parallel, the tertiary and ultimate veinlets strongly reticulate, the under surface thinly gray-tomentose but the midrib and veins more or less tawny villous, petioles 10–14 mm. long, coarse, short villous, stipules not seen; inflorescence axillary and subterminal, paniculate, 10–15 cm. long, pale, tawny, short-villous, the ultimate branches densely flowered, the bracts 5 mm. or less long, broadly ovate, mostly 3 lobed, the lobes usually acute, bracteoles minute, pedicels 1.0–1.5 mm. long; buds obglobose, 1.5–1.75 mm. long, calyx tube short, lobes 1.5 mm. long, ovate-triangular, acute, patent, densely short-villous without, inner surface thinly white pilose, exceeding the 1 mm. long tube, the tube lanate-pilose within, densely so on the throat, apetalous, stamens exserted, the filaments white, ca. 3 mm. long, style pilose below, the ovary densely white lanate-pilose; fruit not seen.

TYPE: tree 80 ft. high, 12 in. diam., leaves chartaceous, flowers in axillary inflorescences, branches widely divergent, buds and inflorescence pale cream to bronze, velvety, flowers white, sepals spreading, filaments white, glabrous, from Eschweilera-Dicymbe forest on brown sand, Madray-Bubu Trail, Essequibo-Demerara Rivers, *Fanshawe 1678* (F.D. 4414). New York Botanical Garden. Known only by the type collection.

LICANIA APETALA (E. Mey.) Fritsch. *L. floribunda* Benth. BRITISH GUIANA: tree 40 ft. high, 8 in. diam., leaves chartaceous, markedly reticulate beneath, flowers in terminal branched inflorescence, rachis, calyx, etc. yellow-brown pubescent, flower creamy, stamens exserted, from savanna fringe on white sand, Orealla savanna, Courantyne River, *F2587* (F.D. 5375); Moruka River, Pomeroon District, *la Cruz 4539;* savanna between Takutu River and Kanuku Mts., *Smith 3275.* British Guiana, Surinam, French Guiana and Brazil.

Licania arachnoidea Fanshawe & Maguire, sp. nov. Arbor parva; ramulis crassis, glabris; foliis anguste oblanceolatis, acutis vel acuminatis, omnino glabris, venis lateralibus supra prominulis, subtus prominentibus, petiolis glabris, transverse rugosis, bipatelliformi-glandulosis; stipulis

lanceolato-subulatis, persistentibus; inflorescentibus paniculatis fusco-arachnoideo-tomentosis, floribus subsessilibus dense glomeratis; calycibus anguste urceolatis, externe dense fusco-arachnoideo-tomentosis, intus albo-lanatis, petalis rhombico-oblanceolatis, staminibus paucis, exsertis; fructibus non visis.

Tree at least 10 m. high and 25 cm. diam., branchlets coarse, glabrous; leaf blades 17–21 cm. long, 4.5–7.0 cm. broad, narrowly oblanceolate, the apex acute to acuminate, wholly glabrous, lateral veins 12–14 pairs, prominulous above, prominent underneath, petioles 8–10 mm. long, transversely rugose and splitting, bearing a pair of prominent disk shaped glands distally, stipules 10–12 mm. long, lance-subulate, somewhat carinate, with an elongate callosity at the base, persistent; inflorescence axillary, paniculate, to 15 cm. long, brown arachnoid-tomentose, the flowers subsessile, densely glomerate on the secondary axes; calyx 3.0–3.5 mm. long, narrowly urceolate, densely brown arachnoid-tomentose externally, the lobes 5, erect, broadly triangular, acute, 0.8–1.0 mm. long, thinly lanate within, petals 5, 1.5 mm. long, exserted, rhombic-oblanceolate, densely white arachnoid, stamens 4–5, exserted, upwardly more or less connivent, the filaments connate into a conical base, attached at the orifice of the calyx tube, the free portion of the filaments ca. 0.3–0.5 mm. long, densely white arachnoid-lanate, the entire androecium 1.5–2.0 mm. high, staminodia 4–5, reduced or vestigial; calyx tube internally tomentose, style equalling the anthers, ca. 3.5–4.0 mm. long, arachnoid, except at the apex; fruit not seen.

TYPE: Tree 30 ft. high, 5 in. diam., leaves leathery, flowers glomerate on branches of inflorescence, all parts clothed with a fawn-brown cottony wool, from Eschweilera-Dicymbe forest, 107 mile, Bartica-Potaro Road, British Guiana, *Fanshawe 1495* (F.D. 4231). New York Botanical Garden. Known only by the type collection.

Licania arachnoidea is most closely related and superficially similar to *L. macrophylla* Benth. but differs strongly in a number of critical points, as the following comparative analysis shows:

L. arachnoidea (type)	*L. macrophylla* (isotype)
1. Paired glands at base of leaf blade raised, elliptic-orbicular.	1. Paired glands depressed, more or less orbicular, sometimes 1 or both obsolete.
2. Stipules more or less membranous, soon disintegrating, with an inconspicuous callosity at the base.	2. Stipules firm, persistent, not soon disintegrating, with a conspicuous callosity at the base.
3. Inflorescence arachnoid-tomentose, flowers densely glomerate on the secondary branches.	3. Inflorescence merely crisped-puberulent, flowers not densely glomerate.
4. Calyx 3.0–3.5 mm. long, narrowly urceolate, densely arachnoid-tomentose.	4. Calyx 3.5–4.0 mm. long, broadly campanulate, merely puberulent.
5. Petals rhombic-oblanceolate.	5. Petals ovate-lanceolate.
6. Stamens 4–5, staminodes 4–5, reduced or vestigial, the staminal ring conic.	6. Stamens mostly 3, staminodes of equal size, mostly 2, staminal ring hardly conic.
7. Ovary densely lanate-tomentose.	7. Ovary merely villous.

LICANIA AXILLIFLORA (Sagot) Hochr. *L. incana* Aubl. var. *axilliflora* Sagot. SURINAM: tree 15 m. high, 30 cm. diam., glomerules short, axillary, seldom terminal, flowers creamy, externally tomentose, the perianth lobes

acutish, subpilose, arachnoid within, stamens mostly 5, equalling the lobes, filaments pilose at the base, young fruit arachnoid-tomentose, deeply sulcate, lateritic soil, mixed wallaba forest, Schmidt Mt., km. 8, Coppenam River drainage, *24862*. British Guiana, Surinam and French Guiana. Possibility a variety of *L. leptostachya* Benth., and so treated by Kleinhootne[50] [for discussions of problems concerning its specificity see Sandwith, Kew Bull. **1931**: 373, and Benoist, Bull. Mus. Paris **25**: 515 (1919)].

LICANIA DENSIFLORA Kleinh. Rec. Trav. Bot. Néerl. **22**: 383. 1925. *L. kanukuensis* Standl. Lloydia **2**: 182. 1939. BRITISH GUIANA: tree 60 ft. tall, 12 in. diam., mixed forest, lateritic hill-slopes, Siba Creek, *F671* (F.D. 3407). SURINAM: tree 20 m. tall, 30 cm. diam., flowers tawny, primary jungle, Posoegronoe, Saramacca River, *24024*. British Guiana, Surinam. Our collection is undoubtedly conspecific with the type of *L. kanukuensis* Standl., *Smith 3420*, and *Smith 3563* from Kanuku Mts., British Guiana; also with *Sandwith 341*, Moraballi Creek, and *Anderson 57*, Amacura River, both likewise of British Guiana. The Sandwith and Anderson collections were compared by Sandwith[51] to authentic material of *L. densiflora* borrowed by himself from Utrecht.

LICANIA DISCOLOR Pilger. SURINAM: tree 30 m. high, 50 cm. diam., profusely flowering, flowers yellowish-green, frequent, stony soil derived from diabase, mixed montane forest, North Ridge, Tafelberg, *24795*. This collection conforms fairly well to the species as described by Pilger, and is similar to *Smith 2270* and *2923*, from British Guiana, so identified by Standley. The flowers of our material have 4–5 stamens. *L. discolor*, in the orginal description, is purported to have 3 stamens. Three stamens are found in the Smith collections. British Guiana to Amazonas, Brazil.

LICANIA ELLIPTICA Standl. SURINAM: tree 15 m. high, 20 cm. diam., leaves pale beneath, flowers creamy, Toekoetoemoe Creek, Headwaters Saramacca River, *24066*.

In our specimens the leaves are proportionately somewhat narrower than those of the type collection, *Krukoff 5014*, from Rio Embira, Amazonas, Brazil. In the type specimens the inflorescence is almost glabrous and the calyx provided with a 0.5 mm. stipe, while in the Surinam specimens the inflorescence is manifestly puberulent and the campanulate calyx sessile. There appear rather consistently to be five stamens in the flowers of both collections, although sometimes one or two of the delicate filaments may not bear anthers, contrary to the statement in the original description (based on *Krukoff 5014*)—"stamina vulgo 3."[52] Hitherto known only from the type collection.

LICANIA GUIANENSIS (Aubl.) Griseb. BRITISH GUIANA: frequent small tree to 3 m. high, 6 cm. diam., mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22949*. Guiana.

LICANIA INCANA Aubl. BRITISH GUIANA, Kaieteur Plateau: shrub to 1.6 m. high, rounded, leaves leathery, glaucous below, flowers creamy, tomentose, dry sandy savanna, *23151*; shrubby, 1 m. high, leaves glaucous beneath, occasional in open savanna, *23266*; Mazaruni Station, *F633* (F. D. 3369). SURI-

[50] Flora Suriname **2**: 435. 1939.
[51] Kew Bull. **1931**: 372.
[52] Field Mus. Publ. Bot. **17**: 255. 1937.

NAM: shrub, occasional, grass savanna, Zanderij II, *23651;* south savanna, Mata, *24982;* Tafelberg: shrub to 3 m. high, leaves silvery-tan beneath, flowers tan, frequent, Savanna II, *24234;* small tree 10 m. tall, 8 cm. diam., buds tan, flowers cream-colored, low bush 1 km. south Savanna I, *24354;* shrub to 4 m. high, leaves whitish beneath, pigmy bush openings, Savanna VIII, *24438;* shrub to 3 m. high, leaves silvery-tan beneath, flowers tan, fruit red-brown, frequent, Savanna VII, *24791.* Guianas.

This species as represented by the above collections is highly polymorphous, the leaves varying considerably in size, and the flowers strikingly so in length (2–4 mm.) and pubescence, some being arachnoid, others merely short-villous within. Larger flowered forms seem to dominate on the inland plateaus, smaller flowered ones on coastal savannas. Possibly ecologic variants have been segregated out of the complex.

LICANIA HETEROMORPHA Benth. BRITISH GUIANA: tree 100 ft. high, 20 in. diam., unbuttressed, stamens 4, Moraballi Creek, *F265* (F.D. 3001); tree 120 ft. high, 16 in. diam., stamens 4, Mazaruni Station, *F650* (F.D. 3386); tree 90 ft. tall, 12 in. diam., fruit globose, gray-brown, cracked, woody, flesh thick and corky, kernel pink, Mazaruni Station, *F1358* (F.D. 4094); Barabara Creek, Lower Essequibo River, *F944* (F.D. 3680); tree 40 ft. high, 8 in. diam., Mazaruni River by Kaow Creek, *F1336* (F.D. 4072); Kaituma River, Barima River, *F2469* (F.D. 5205). The following three collections are questionably assigned to *L. heteromorpha,* having both oblanceolate blades with relatively longer petioles and short pink or white, erect petals: tree 90 ft. high, 12–16 in. diam., Mazaruni Station, *F607* (F. D. 3343), *F1420* (F.D. 4156), and *F1981* (F.D. 4717). A frequent forest tree, British Guiana, Surinam, French Guiana, Brazil. The species is perhaps too broadly interpreted here. It is hoped later critically to review *L. heteromorpha* in its various racial aspects.

Licania laxa Fanshawe & Maguire, sp. nov. Arbor mediocris; ramulis crassis, minute puberulentibus; foliis lanceolatis, basibus subconduplicatis, apicibus acutis subconduplicatis, glabris, venis supra prominulis, subtus valde prominentibus, petiolis arcuatis, brevissimo-villosis, stipulis lineari-lanceolatis, subcoriaceis, puberulentibus; inflorescentibus paniculatis, laxe pendulosis, cymulis subsessilibus; calycibus turbinato-campanulatis aliquantum sulcatis; fructibus maturis non visis.

Tree at least 70 ft. tall and 16 in. diam., branches coarse, minutely puberulent, soon glabrate; leaf blades 10–12 cm. long, 3.5–5.0 cm. broad, lanceolate, the base subcordate, V-shaped in cross-section, particularly at the recurved apex and base, hence, when pressed flat, the apical and basal surfaces partially adpressed, glabrous, primary veins 7–8 pairs, strongly arching upwards, prominulous above, strongly prominent beneath, secondary veinlets faintly transversely reticulate, the petiole 5 mm. long, very short brown-villous, stipules 5 mm. long, linear-lanceolate, puberulent, subcoriaceous; inflorescence terminal, paniculate, 17 cm. long, grayish brown villous, short, the branches pendulous, densely spicate, the cymules subsessile, bracts linear-lanceolate, 3–4 mm. long, bracteoles triangular, shorter; the calyx 3.0–4.0 mm. long, turbinate-campanulate, somewhat sulcate, lobes ovate, ca. 1 mm. long, stamens 7–8 (10), the oppositisepalous, longer with filaments ca. 1 mm. long, calyx tube short villous within, ovary densely villous, style villous at the base, pilose upwards, the apex appendage-like, con-

stricted and glabrous; young fruit elongate brown villous with paler intermixed longer hairs, mature fruit not seen.

TYPE: tree 70 ft. tall, 16 in. diam., leaves glabrous, strongly nerved, flowers in terminal inflorescence, spikes densely flowered, flowers cream, campanulate, young fruit rusty-tomentose, resembles *L. venosa* in bark and habit, from island of bush in falls, Kurihi Rapids, Essequibo River, British Guiana, *Fanshawe 1665* (F.D. 4401). New York Botanical Garden. Known only by the type collection.

The large flowers resemble those of *L. majuscula* Sagot which are described as ½ cm. long, and as having 15 stamens. The large drooping inflorescence and glabrous, apically and basally recurved, subconduplicate leaves make this a strongly marked species.

LICANIA LAXIFLORA Fritsch. BRITISH GUIANA: tree 15 m. high, 30 cm. diam., fruit rusty-tomentose, wrinkled, occasional, on white sand, mixed forest, Potaro River below Tukeit, *23511;* Mahdia River, Potaro River, 107 mile Bartica-Potaro Road, *F1019* (F.D. 3755), *F1020* (F.D. 3756). Known only from British Guiana.

LICANIA MICRANTHA Miq. BRITISH GUIANA: tree 100 ft. tall, 20 in. diam., leaves buff underneath, flowering stems glaucous, relic in secondary forest in light brown sand plain behind station, replaces *L. densiflora* on loose colored sand of the area, Mazaruni Station, *F324* (F.D. 3060); Demerara River, la Cruz *2739;* Wismar, *Persaud 79.* By letter Mr. N. Y. Sandwith has supplied the following additional records that should go here: Mazaruni Station, *F204* (F.D. 2940); Essequibo River, *Jenman 1314;* and, Little Wineperu Creek, *F400* (3136). British Guiana, Surinam, Brazil. Apparently unrecorded for British Guiana.

Licania microphylla Fanshawe & Maguire, sp. nov. Arbor mediocris, ramulis tenuis, puberulentis; foliis parvis, ovatis vel elliptico-ovatis, supra glabris, subtus dense tomentosis, petiolis brevibus, puberulentibus, bipatelliformi-glandulosis, stipulis brevibus, subulatis, puberulentibus; inflorescentibus spicatis vel subpaniculatis; floribus non visis; fructibus obovatis, stipitatis, subquadrangularibus, indumentibus dense compactis, reticulato-rugulosulis.

Tree at least 18 m. high and 15 cm. diam., unbuttressed, branchlets slender, puberulent, becoming glabrate, inconspicuously lenticellate; leaves 3–4 cm. long, 1–2 cm. broad, ovate to elliptic-ovate, primary veins 5–6 pairs, ascending at a 45° angle with the midrib, upper surface glabrous, drying brown, veins feebly impressed, faintly reticulate, lateral veins inconspicuous on the lower surface, tomentum dense, uniform, tan in color, all but obscuring the underlying reticulum, petioles 2–3 mm. long, puberulent, with 1 or mostly 2 patelliform glands at the base of the blade; stipules 2 mm. long, linear-subulate, puberulent; inflorescences lateral and terminal, spicate or somewhat paniculate, apparently 8 cm. or less long, puberulent, densely flowered, the flowers sessile, the bracts ca. 0.7 mm. long, acutish; flowers not seen; fruit ca. 1 cm. long, 6–8 mm. thick, obovate, obscurely quadrangular, abruptly stipitate, the stipe 3–4 mm. long, indument dense, compact, granular, reticulate-rugulose, tan in color.

TYPE: tree 50 ft. high, 6 in. diam., unbuttressed, leaves small, chartaceous, fruit in axillary and terminal spikes, obovoid, squarish, dull red, from mixed forest on colored sands, Mahdia River, Potaro River, 107 mile, Bartica-

Potaro Road, British Guiana, *Fanshawe 1078* (F.D. 3814). New York Botanical Garden. Known only by the type collection.

Licania microphylla is most closely related to the diversified *L. parviflora* of Pará and northern Brazil.

LICANIA MOLLIS Benth. BRITISH GUIANA: tree 90 ft. tall, 16 in. diam., unbuttressed, leaves stiff, velvety below, margin involute, from *Eschweilera-Dicymbe* forest on lateritic ironstone soil, Mahdia River, Potaro River, 107 mile, Bartica-Potaro Road, *F1032* (F.D. 3768); tree 80 ft. tall, 10 in. diam., unbuttressed, *Dicymbe* forest on white sand, data otherwise as above, *F1059* (F.D. 3795). Apparently previously unreported from British Guiana.

LICANIA MINUTIFLORA (Sagot) Fritsch. BRITISH GUIANA: tree 135 ft. high, 24 in. diam., (grows to 150 ft. high and 36 in. diam.), low buttresses to 3 ft., leaves chartaceous, panicle and calyx velvety with a close tomentum of buff hairs, buds yellowish, calyx patent in flower, corolla creamy deciduous as flower opens, stamens in a ring, basally connate, hairy, style and ovary hairy, mixed Kautaballi forest on brown sand, Makauria Creek, Essequibo River, *F598* (F.D. 3334); Takutu Creek, Mazaruni River, *F2004* (F.D. 4740). British and French Guiana. Previously unreported for British Guiana.

Licania paniculata Fanshawe & Maguire, sp. nov. Arbor parva; foliis amplis, elliptico-oblanceolatis, brevi-acuminatis, stipulis persistentibus, coriaceis, lineari-subulatis; inflorescentibus paniculatis, fasciculatis, calycibus substipitatis, gibboso-campanulatis; petalis obsoletis; fructibus non visis.

A tree at least 12 m. tall, 15 cm. diam., branchlets slender, terete, ash-gray; petioles 4–6 mm. long, terminating in two more or less prominent callosities that are subdecurrent on the base of the blade, the blade 15–20 cm. long, 5.5–7.5 cm. broad, elliptic-oblanceolate, short acuminate at the apex, the base obtuse or only somewhat acute, chartaceous, primary veins 7–8 pairs, arcuate upwards and finally anastamosing 2–3 mm. from the margins, upper surface glabrous, lower surface with a smooth, close, granular, silvery-tan tomentulum; stipules persistent, ca. 4 mm. long, coriaceous, linear-subulate, glabrous; inflorescence paniculate, axillary and subterminal, fascicled, usually 3–10 peduncles per node, 10–13 cm. long, the branches angled, minutely puberulent, the bracts soon falling, bracteoles ca. 1 mm. long, triangular, acute, puberulent, cymules 3-flowered, subsessile, or the pedicel as much as 1.5 mm. long; calyx gibbose-campanulate, ca. 2.75 mm. long, the lobes ovate, obtuse, 0.75 mm. long, closely tomentulose outside, inconspicuously pubescent within, corolla obsolete or represented by a distinctly discernible ring, stamens 5 (7), filaments slender, ca. 0.5 mm. long; fruit not seen.

TYPE: tree 12 m. high, 15 cm. diam., wood hard, flowers cream-colored, mixed forest, Toekoemoetoe Creek, Saramacca River, Surinam, *Maguire 24068*. New York Botanical Garden. Known only by the type collection.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

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ALGAE

(See under Plant Physiology: **Whitford**)

Aitken, Mary M. Isolation of blue-green algae for pure culture. Proc. Ind. Acad. **56**: 77–79. 1947.

Fletcher, Joel E. & Martin, W. P. Some effects of algae and molds in the rain-crust of desert soils. Ecology **29**: 95–100. *f. 1–3* + *table 1*. Ja 1948.

Le Gallo, *Père* C. Algues marines des îles Saint-Pierre et Miquelon. Nat. Canad. **74**: 293–318. *f. 1–6*. N–D 1947 [Ja 1948].

Wood, R. D. Characeae of the Put-in-Bay region of Lake Erie [Ohio]. Ohio Jour. Sci. **47**: 240–258. *pl. 1–4*. N 1947 [Ja 1948].

FUNGI AND LICHENS

(See also under Algae: **Fletcher & Martin**; under Plant Physiology: **Hausman**)

Ajello, Libero. A cytological and nutritional study of *Polychytrium aggregatum*. I. Cytology. Am. Jour. Bot. **35**: 1–12. *f. 1–40*. Ja [F] 1948.

Barnett, H. L. & Lily, Virgil Greene. The relation of thiamin to the production of perithecia by *Ceratostomella fimbriata*. Mycologia **39**: 699–708. N–D 1947 [6 Ja 1948].

Cocke, Elton C. Observations on gonidia formation in *Cylindrospermum*. Jour. Elisha Mitchell Soc. **63**: 213, 214. D 1947.

Coker, W. C. North Carolina species of *Volvaria*. Jour. Elisha Mitchell Soc. **63**: 220–230. *pl. 28–32*. D 1947.

Cummins, George B. Some problems in mycological taxonomy. Mycologia **39**: 627–637. *port.* N–D 1947 [6 Ja 1948].

Jackson, H. S. *Trichomonascus*, a new genus among simple Ascomycetes. Mycologia **39**: 709–715. *f. 1–20*. N–D 1947 [6 Ja 1948].

Kanouse, Bessie B. A survey of the Discomycete flora of the Olympic National Park and adjacent areas. Mycologia **39**: 635–689. *f. 1–35*. N–D 1947 [6 Ja 1948].

Kelman, Arthur. A rare species of *Isoachyla* found in North Carolina. Jour. Elisha Mitchell Soc. **63**: 207–211. *pl. 27*. D 1947.

Korf, Richard P. *Seaverinia Geranii*. Mycologia **39**: 743. N–D 1947 [6 Ja 1948].

Luttrell, E. S. The morphology of *Ellisiodothis inquinans*. Am. Jour. Bot. **35**: 57–64. *f. 1–36* + *table 1*. Ja [F] 1948.

Magnusson, A. H. Some lichens from Argentina. Acta Hort. Gothob. **17**: 59–76. 18 Je 1947.

Martínez, Argentino. Nota sobre un hongo invasor de los cultivos de *Agaricus campestris*. Revista Argent. Agron. **14**: 273–278. *pl. 4* + *f. 1*. D 1947.

Seaver, Fred J. Fungi [of Guiana] *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—I. Bull. Torrey Club **75**: 60–63. *f. 3*. 29 Ja 1948.

Simmons, Emory G. Studies in the stromatic Sphaeriales of Indiana. Proc. Ind. Acad. **56**: 38–74. 1947.

Singer, Rolf & Smith, Alexander H. Additional notes on the genus *Leucopaxillus*. Mycologia **39**: 725–736. *f. 1–3*. N–D 1947 [6 Ja 1948].

Sprague, Roderick & Johnson, A. G. *Selenophoma* on grasses, III. Mycologia **39**: 737–742. N–D 1947 [6 Ja 1948].

Waterman, Alma M. & Marshall, Rush P. A new species of *Cristulariella* associated with a leaf spot of maple. Mycologia **39**: 690–698. *f. 1, 2*. N–D 1947 [6 Ja 1948].

Wilhelm, Stephen. The dual phenomenon in the dermatophytes. Mycologia **39**: 716–724. *f. 1, 2*. N–D 1947 [6 Ja 1948].

BRYOPHYTES

Bartram, Edwin B. Musci [of Guiana]. *In:* Maguire, *B. et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—I. Bull. Torrey Club **75**: 64–66. 29 Ja 1948.

Fulford, Margaret H. Hepaticae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—I. Bull. Torrey Club **75**: 64. 29 Ja 1948.

Jovet-Ast, S. Hepatiques des Antilles francaises recoltees par P. et V. Allorge en 1936. Revue Bryol. Lichenol. II. **6**: 17–46. *f. 1–X*. 1947.

Wagner, Kenneth A. Additional distribution records of Hepaticae in Indiana. Proc. Ind. Acad. **56**: 86–91. *f. 1*. 1947.

Wagner, Kenneth A. A consideration of some reports in Indiana liverworts. Proc. Ind. Acad. **56**: 92–94. 1947.

PTERIDOPHYTES

Copeland, Edwin Bingham. *Cyathea* in New Guinea. Philipp. Jour. Sci. **77**: 95–124. *pl. 1–15*. Je 1947.

Dix, W. L. The ferns of Wayne County, Pennsylvania. Am. Fern Jour. **37**: 100–110. 29 D 1947.

Hall, Carlotta C. A *Pellaea* of Baja California. Am. Fern Jour. **37**: 111–114. *pl. 6*. 29 D 1947.

Maxon, William R. & Morton, C. V. Pteridophyta [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—I. Bull. Torrey Club **75**: 66–80. 29 Ja 1948.

Morton, C. V. Some notes on Hawaiian Asplenieae. Am. Fern Jour. **37**: 114–119. 29 D 1947.

Raymond, Marcel & Kucyniak, James. *Dryopteris hexagonoptera* in Quebec. Am. Fern Jour. **37**: 97–99. 29 D 1947.

Shanks, Royal E. *Trichomanes boschianum* Sturm at Sewanee, Tennessee. Jour. Tenn. Acad. **22**: 146–148. 1947.

Weatherby, C. A. *Asplenium montanum* in south-central Massachusetts. Rhodora **50**: 20. 13 Ja 1948.

Weatherby, C. A. Glandular *Cystopteris fragilis* in the Rocky Mountains. Am. Fern Jour. **37**: 122, 123. 29 D 1947.

Wherry, Edgar T. A crispate variant of the Christmas fern. Am. Fern Jour. **37**: 121. 29 D 1947.

Wiggins, Ira L. A fern new to Baja California. Am. Fern Jour. **37**: 119, 120. 29 D 1947.

SPERMATOPHYTES
(See also under Morphology: **Bailey & Nast**)

Abbe, Ernst C. *Braya* in boreal eastern America. Rhodora **50:** 1–15. *pl. 1088–1090.* 13 Ja 1948.

Abbiatti, Delia. Las Eriocaulaceas argentinas. Revista Mus. La Plata Bot. 6[26]: 311–341. *pl. 1, 2 + f. 1–10.* 28 F 1946.

Airy Shaw, H. K. Typification of new names derived fiom persons or places. Kew Bull. **1:** 35–39. 1947.

Bailey, L. H. Indigenous palms of Trinidad and Tobago. Gent. Herb. **7:** 353–445. *f. 143–210.* 27 D 1947.

Bailey, L. H. Palmae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and Kaieteur Plateau—I. Bull. Torrey Club **75:** 102–115. *f. 5–13.* 29 Ja 1948.

Barkley, Fred A. Texas plant collectors as represented in Texas herbaria. Am. Midl. Nat. **38:** 638–670. *tables 1, 2.* N 1947 [Ja 1948].

Blake, S. T. The Cyperaceae collected in New Guinea by L. J. Brass, III. Jour. Arnold Arb. **29:** 90–102. *f. 1. 15 Ja 1948.*

Buchholz, John T. & Gray, Netta E. A taxonomic revision of *Podocarpus.* I. The sections of the genus and their subdivisions with special reference to leaf anatomy. Jour. Arnold Arb. **29:** 49–76. *pl. 1–4.* 15 Ja 1948.

Burkart, Arturo. Leguminosas neuvas o criticas, II. Darwiniana **7:** 504–540. *f. 1–7.* 17 S 1947.

Cabrera, Angel L. & Saravi Cisneros, Rodolfo. Malezas bonarienses. Bol. Agr. Dir. Agr. Ind. La Plata 26[10]: 1–18. *f. 1–19.* 31 D 1946.

Carter, George F. Some archaeologic cucurbit seed from Peru. Acta americana [Mexico] **3:** 163–172. Jl–S 1945.

Conzatti, Casiano. Flora taxonómica mexicana [Monocotiledoneas: Diperiantadas—Superovaricas e Inferovaricas]. **2:** 1–220. 24 S 1947.

Correll, Donovan, S. Additions to the orchids of Texas. Wrightia **1:** 166–182. *f. 6–10.* 15 D 1947.

Croizat, L. Notes on the Euphorbiaceae III. Bull. Bot. Gard. Buitenzorg **17:** 209–219. Ap 1942

Cronquist, Arthur. Notes on the Compositae of the northeastern United States. VI. Cichorieae, Eupatorieae and Astereae. Rhodora **50:** 28–35. F 1948.

Dahl, Eilef. Two new plants from Greenland. Nytt Mag. Naturvid. **82:** 101–104. *f. 1, 2.* 25 Mr 1941.

Ducke, Adolfo. Novas contribuições para o conhecimento das seringueiras da Amazônia Brasileira II. Bol. Téc. Inst. Agron. Norte [Bélém] **10:** 1–24. 29 D 1946.

Ducke, Adolfo. Plantas de cultura precolombiana na Amazônia Brasileiro. Notas sôbre as especies ou formas espontâneas que supostamente ihes teriam dado origem. Bol Téc. Inst. Agron. Norte [Belém] **8:** 1–24. 29 Je 1946.

Fernald, M. L. Another aggressive hawkweed. Rhodora **50:** 15. 13 Ja 1948.

Fernald, M. L. A Nova Scotian dwarf shadbush. Rhodora **50:** 49–51. F 1948.

Fernald, M. L. A prostrate *Rorippa.* Rhodora **50:** 35. F 1948.

Flovik, Karl. The chromosome number of some species of *Carex* and *Eriophorum.* Nytt Mag. Naturvid. **83:** 77, 78. 27 Je 1942.

Giardelli, Maria Luisa. Nota sobre una Lemnácea tropical poco conocida: "*Wolffia Welwitschii*" Hegelm. Darwiniana **7:** 552–556. *1 map.* 17 S 1947.

Groh, H. Hackberry in and adjacent to the Province of Quebec. Canad. Field Nat. **61:** 141, 142. Jl–Au 1947.

Gustafsson, Ake. Polyploidy, life-form and vegetative reproduction. Hereditas **34:** 1–22. 23 Ja 1948.

Gutaffson, Ake. Apomixis in higher plants. Part II. The causal aspect of apomixis. Lunds Univ. Arssk. II. Sect. 2. **43**[2]: 71–179. *f. 21–29.* 23 My 1947. Part III. Biotype and species formation. **43**[12]: 183–371. 29 N 1947.

Habeeb, Herbert. *Campylium Halleri* in New Brunswick. Rhodora **50:** 52. F 1948.

Hara, Hiroshi. The nomenclature of the flowering dogwood and its allies. Jour. Arnold Arb. **29:** 111–115. 15 Ja 1948.

Hermann, Frederick J. Studies in *Lonchocarpus* and related genera, I: A synopsis of *Willardia.* Jour. Wash. Acad. **37:** 427–430. 31 D 1947.

Hermann, Frederick J. Studies in *Lonchocarpus* and related genera, II: Miscellaneous middle America *Lonchocarpi.* Jour. Wash. Acad. **38:** 11–14. 15 Ja 1948.

Hitchcock, C. Leo & Maguire, Bassett. A revision of the North American species of *Silene.* Univ. Wash. Publ. Biol. **13:** *i–iii,* 1–73. *pl. 1–8.* 31 Jl 1947.

Hultén, Eric. Flora of Alaska and Yukon—VII. Dicotylednoeae. Rosales III. (Geraniales, Sapindales, Parietales, Myrtiflorae, Umbelliflorae.) Lunds Univ. Arssk. II. Sect. 2 **43**[1]: 1069–1200. *f. 804–905.* 1947.

Ibarra, Florinda E. & La Porte, Juan. Las Crucíferas del género *Diplotaxis* adventicias en la Argentina. Revista Argent. Agron. **14:** 261–272. *f. 1–3.* D 1947.

Isely, Duane. *Lespedeza striata* and *L. stipulacea.* Rhodora **50:** 21–27. *pl. 1091, 1092.* F 1948.

Jonker, F. P. Alisamaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau. I. Bull. Torrey Club **75:** 81. 29 Ja 1948.

Krainz, H. *Lobivia vatterii* Krainz spec. nov. Sukkulentenkunde **1:** 7, 8. *2 f.* [Type: living pl. from Argentina]. Je 1947.

Lakela, Olga. Notes on Minnesota plant-life. Rhodora **50:** 19, 20. 13 Ja 1948.

Larsen, Eugene C. Photoperiodic responses of geographic strains of *Andropogon scoparius.* Bot. Gaz. **109:** 132–149. *f. 1–6.* D 1947 [30 Ja 1948].

Lawrence, William E. Chromosome numbers in *Achillea* in relation to geographic distribution. Am. Jour. Bot. **34:** 538–545. *f. 1–3 + table 1.* D 1947 [4 F 1948].

Lourteig, Alicia. Primulaceae argentinae. Addenda. Darwiniana **7:** 556–559. *pl. 1.* 17 S 1947.

Lundell, Cyrus Longworth. A new species of *Dracocephalum* L. from Texas. Wrightia **1:** 165. 15 D 1947.

Maguire, Bassett *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—I. Bull. Torrey Club **75:** 56–115. *f. 1–13.* 29 Ja 1948. II. **75:** 189–230. *f. 14–17.* Mr. 1948.

McVaugh, Rogers. Generic status of *Triodanis* and *Specularia.* Rhodora **50:** 38–49. F 1948.

Merrill, E. D. On the control of destructive insects in the herbarium. Jour. Arnold Arb. **29:** 103–110. 15 Ja 1948.

Moore, Raymond J. Cytotaxonomic studies in the Loganiaceae. I. Chromosome numbers and phylogeny in the Loganiaceae. Am. Jour. Bot. **34:** 527–538. *f. 1–30 + tables 1, 2.* D 1947 [4 F 1948].

Palmer, Ernest J. Hybrid oaks of North America. Jour. Arnold Arb. **29:** 1–48. 15 Ja 1948.

Pearson, Norma L. Variations of floss characteristics among plants of *Asclepias syriaca* L. having different types of pods. Am. Midl. Nat. **38:** 615–637. *f. 1–7 + tables 1–5.* N 1947. [Ja 1948].

Peck, M. E. Native rhododendrons of the Pacific northwest. Rhododendron Yearb. **1947:** 87–89. 1947.

Pennell, Francis W. Some hitherto undescribed Scrophulariaceae of the Pacific States. Proc. Acad. Nat. **99:** 155–199. 5 N 1947.

Pohl, Richard W. A taxonomic study on the grasses of Pennsylvania. Am. Midl. Nat. **38:** 513–604. *1 map.* N 1947 [Ja 1948].

Ponce de León, Antonio. Joyas de la flora cubana. El corojo (*Acrocomia armentalis* Bailey). Revista Soc. Cub. Bot. **4:** 3. *1 pl.* Ja–Mr 1947.

Ponce de León y Carrillo, Patricio. *Nuphar advena Cubana* var. nova. Revista Soc. Cub. Bot. **4:** 9–16. *f. 1–13.* Ja–Mr 1947.

Porsild, Morten P. The Greenland *Achillea.* Medd. Grønland **134:** 36–39. *f. 7–9.* 27 Au 1947.

Porsild, Morten P. On *Carex rufina* Drejer. Medd. Grønland **134:** 26–36. *f. 5, 6.* 27 Au 1947.

Porsild, Morten P. *Potamogeton groenlandicus* Hagstrom. Medd. Grønland **134:** 18–26. *f. 3, 4.* 27 Au 1947.

Porsild, Morten P. *Potentilla hyparctica* Malte. Medd. Grønland **134:** 10–18. *f. 2.* 27 Au 1947.

Porsild, Morten P. What is *Antennaria Hansii* Kern? Medd. Grønland **134:** 3–9 *f. 1.* 27 Au 1947.

Quisumbing, Eduardo. Philippine plants used for arrow and fish poisons. Philipp. Jour. Sci. **77:** 127–177. Je 1947.

Raymond, Marcel. A red-fruited form of *Podophyllum peltatum.* Rhodora **50:** 18. 13 Ja 1948.

Riddle, Matthew C. *Iris innominata*—The Cinderella of the Pacific Coast irises. Jour. Calif. Hort. Soc. **9:** 13–18. Ja 1948.

Sherff, Earl Edward. Further studies in the genus *Dodonaea* L. (family Sapindaceae). Field Mus. Nat. Hist. Publ. Bot. **23:** 269–317. 22 D 1947.

Sherff, Earl Edward. A preliminary study of Hawaiian species of the genus *Rauvolfia* [Plum.] L. (family Apocynaceae). Field Mus. Nat. Hist. Publ. Bot. **23:** 321–331. 30 D 1947.

Sherff, Earl Edward. Additions to the genera *Scalesia* Arn. and *Hidalgoa* Llove and Lex. (family Compositae). Field Mus. Nat. Hist. Publ. Bot. **23:** 333–336. 30 D 1947.

Shinners, Lloyd H. Revision of the genus *Krigia* Schreber. Wrightia **1:** 187–206. 15 D 1947.

Shinners, Lloyd H. Two anomalous new species of *Erigeron* L. from Texas. Wrightia **1:** 183–186. 15 D 1947.

Skottsberg, C. Eine kleine Pflanzensammlung von San Ambrosio (Islas Desventuradas, Chile). Acta Hort. Gothob. **17:** 49–57. *f. 1–41.* 17 Je 1947.

Skottsberg, C. The genus *Peperomia* in Chile. Acta Hort. Gothob. **17:** 1–47. *f. 1–76.* 17 Je 1947.

Skottsberg, C. Notes on some annual species of *Adesmia* DC. from central Chile. Acta Hort. Gothob. **17:** 165–190. *f. 1–85.* 31 O 1947.

Stehlé, H. Notes taxonomiques et géographies sur des Graminées et Cypéràcées nouvelles des Antilles françaises. Not. Syst. [Paris] **13:** 72–97. Je 1947.

Svenson, Henry K. Cyperaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explor-

ations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau —I. Bull. Torrey Club **75**: 91–102. *f. 3, 4.* 29 Ja 1948.

Swallen, Jason R. Gramineae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau —I. Bull. Torrey Club **75**: 81–91. 29 Ja 1948.

Woodson, Robert E. Sone dynamics of leaf variation in *Asclepias tuberosa.* Ann. Mo. Bot. Gard. **34**: 353–432. *pl. 45, 46 + f. 1–15 + tables 1–14 + maps 1–6.* N 1947.

ECOLOGY AND PLANT GEOGRAPHY

Bechtel, A. R. A ten-year-old forest in Lye Creek prairie, Montgomery County [Indiana]. Proc. Ind. Acad. **56**: 80–83. *f. 1, 2.* 1947.

Bentley, J. R. & Talbot, M. W. Annual-plant vegetation of the California foothills as related to range management. Ecology **29**: 72–79. *f. 1.* Ja 1948.

Bruce, David. Thirty-two years of annual burning in longleaf pine. Jour. Forest. **45**: 809–814. *f. 1–4.* N 1947.

Buell, Murray F. Mass dissemination of pine pollen. Jour. Elisha Mitchell Soc. **63**: 163–167. *f. 1, 2.* D 1947.

Daubenmire, Rexford F. Plants and environment, a textbook of plant autecology. *i–xiii,* 1–424. *illust.* Wiley. New York. 1947.

Good, Ronald. The geography of the flowering plants. 1–403. *pl. 1–24 + f. 1–71.* Longmans, Green & Co. London and New York. 1947.

Penfound, William T. A phytosociological analysis of a goldenrod community near Kenner, Louisiana. Ecology **29**: 124, 125. *table 1.* Ja 1948.

Potts, Roberta & Penfound, William T. Water relations of the polypody fern, *Polypodium polypodioides* (L.) A. S. Hitchcock. Ecology **29**: 43–53. *f. 1–4 + tables 1–3.* Ja 1948.

Reed, John F. The relation of the Spartinetum glabrae near Beaufort, North Carolina to certain edaphic factors. Am. Midl. Nat. **38**: 605–614. *tables 1, 2.* N 1947 [Ja 1948].

Weaver, J. E. & Darland, R. W. Changes in vegetation and production of forage resulting from grazing lowland prairies. Ecology **29**: 1–20. *f. 1–28.* Ja 1948.

PHYTOPATHOLOGY

Baker, Kenneth F. Seed transmission of *Rhizoctonia solani* in relation to control of seedling damping-off. Phytopathology **37**: 912–924. *f. 1, 2.* D 1947.

Bever, Wayne M. Physiologic races of *Ustilago tritici* in the eastern soft wheat region of the United States. Phytopathology **37**: 889–895. *f. 1–3.* D 1947.

Cooley, J. S. Natural infection of replanted apple trees by white root rot fungus. Phytopathology **38**: 110–113. *table 1.* F 1948.

Crandall, Bowen S. *Cinchona* root disease caused by *Phytophthora cinnamomi.* Phytopathology **37**: 928, 929. D 1947.

Crandall, Bowen S. *Phytophthora cinnamomi* root rot of avocados under tropical conditions. Phytopathology **38**: 123–130. *f. 1.* F 1948.

Demaree, J. B. *Thelephora terrestris* on blueberry plants. Phytopathology **37**: 930, 931. *f. 1.* D. 1947.

Dunegan, John C. The occurrence of *Monilinia Seaveri* on English morello cherry. Phytopathology **37**: 929, 930. *f. 1.* D 1947.

Ergyle, David R. The carbohydrate metabolism of germinating *Phymatotrichum*

sclerotia with special reference to glycogen. Phytopathology **38**: 142–151. *f. 1–3 + tables 1, 2.* F 1948.

Fenner, Lawrence M. & Fate, Leston R. *Ceratostomella ulmi* on elm bark treated with 2,4-dichlorophenoxyacetic acid. Phytopathology **37**: 925–928. *f. 1–3.* D 1947.

Foster, H. H. & Pinckard, J. A. Control of cabbage downy mildew with benzene vapor. Phytopathology **37**: 896–911. *f. 1–3 + tables 1–7.* D 1947.

Hartzell, Albert. Additional tests of plant products for insectidal properties and summary of results to date. Contr. Boyce Thompson Inst. **15**: 21–34. *tables 1–4.* O–D 1947.

Hoppe, P. E. Seed treatment with mercury dusts injurious to corn with mechanical injuries near embryo. Phytopathology **38**: 81. *f. 1.* Ja 1948.

Huber, Glenn A. & Gould, C. J. *Sclerotium delphinii* Welch on scilla. Phytopathology **38**: 82–85. *f. 1.* Ja 1948.

Kreitlow, K. W. *Urocystis agropyri* on *Phleum pratense.* Phytopathology **38**: 158, 159. F 1948.

MacLean, Neil Allan. *Rhizoctonia* rot of tulips in the Pacific northwest. Phytopathology **38**: 156, 157. *f. 1.* F 1948.

Mader, E. O. & Feldman, A. W. Physiological exhaustion of strawberry plants as a factor in winter killing. Phytopathology **38**: 137–141. F 1948.

Martin, W. J. The occurrence of South American leaf blight of *Hevea* rubber trees in Mexico. Phytopathology **38**: 157, 158. F 1948.

Miller, V. L., Johnson, Folke & Allmendinger, D. F. Fluorine analysis of Italian prune foliage affected by marginal scorch. Phytopathology **38**: 30–37. *f. 1, 2 + tables 1–3.* Ja 1948.

Newhall, A. G. & Lear, Bert. Soil fumigation for fungus control with methyl bromide. Phytopathology **38**: 38–43. *f. 1, 2 + tables 1–5.* Ja 1948.

Nienow, Inez. The indentification and characterization of a virus causing mosaic in *Mertensia virginia.* Phytopathology **38**: 62–69. *f. 1 + tables 1–4.* Ja 1948.

Rhoades, Arthur, S. *Clitocybe* root rot of citrus trees in Florida. Phytopathology **38**: 44–61. *f. 1–6.* Ja 1948.

Siggers, Paul V. Temperature requirements for germination of spores of *Cronartium fusiforme.* Phytopathology **37**: 855–864. *f. 1 + tables 1, 2.* D 1947.

Sprague, Roderick. *Gloeosporium* decay in Gramineae. Phytopathology **38**: 131–136. *f. 1.* F 1948.

Stoddard, David L. Nitrogen, potassium, and calcium in relation to *Fusarium* wilt of muskmelon. Phytopathology **37**: 875–884. *f. 1 + tables 1–7.* D 1947.

Szkolnik, Michael. Antagonistic activity of a species of *Actinomyces* against *Ceratostomella ulmi* in vitro. Phytopathology **38**: 85–87. *f. 1.* Ja 1948.

Thirumalacher, M. J. & Dickson, J. G. A *Physoderma* disease of quack grass. Phytopathology **37**: 885–888. *f. 1, 2.* D 1947.

Thomas, Harold E. *et al.* Rootstock susceptibility to *Armillaria mellea.* Phytopathology **38**: 152–154. *tables 1, 2.* F 1948.

Tompkins, C. M. & Hansen, H. N. *Cyclamen* petal spot, caused by *Botrytis cinerea* and its control. Phytopathology **38**: 114–117. *f. 1, 2.* F 1948.

Tompkins, C. M. & Tucker, C. M. Stem rot of *Dieffenbachia picta* caused by *Phytophthora palmivora* and its control. Phytopathology **37**: 868–874. *f. 1–4.* D 1947.

Whitaker, Thomas W. & Pryor, Dean E. Correlated resistance of leaves, cotyledons, and stems of *Cucumis melo* L. to cantaloupe powdery mildew (*Erysiphe cichoracearum* DC.) Phytopathology **37**: 865–867. *table 1.* D 1947.

MORPHOLOGY

(including anatomy & cytology in part)
(See also under Fungi & Lichens: **Ajello**; under Spermatophytes: **Buchholz & Gray**)

L **Bailey, I. W. & Nast, Charlotte G.** Morphology and relationships of *Illicium, Schisandra* and *Kadsura.* I. Stem and leaf. Jour. Arnold Arb. **29:** 77–89. *pl. 1–6.* 15 Ja 1948.

Giles, N. H. Chromosome structural changes in *Tradescantia* microspores produced by absorbed radiophosphorus. Proc. Nat. Acad. **33:** 283–287. O 1947.

Granick, S. & Porter, K. R. The structure of the spinach chloroplast as interpreted with the electron microscope. Am. Jour. Bot. **34:** 545–550. *f. 1–6.* D 1947. [4 F 1948].

Heintzelman, Charles E. & Howard, Richard A. The comparative morphology of the Icacinaceae. V. The pubescence and the crystals. Am. Jour. Bot. **35:** 42–52. *f. 1–64 tables 1, 2.* Ja [F] 1948.

Kaufmann, Berwind, P. Chromosome structure in relation to the chromosome cycle. II. Bot. Rev. **14:** 57–126. F 1948.

Lemos Pereira, Alice de. Sobre o citoplasma e a membrana da célula vegetal. Bol. Soc. Brot. II. **17:** 167–181. *pl. 1–10.* 1943.

Madsen, Grace C. Influence of photoperiod on microsporogenesis in *Cosmos sulphureus* Cav. var. Klondike. Bot. Gaz. **109:** 120–132. *f. 1–34.* D 1947 [30 Ja 1948].

Maheshwari, P. The angiosperm embryo sac. Bot. Rev. **14:** 1–56. Ja 1948.

Mendes, Luiz O. T. Investigações preliminares sôbre o duplicação do número de cromosomios da seringueira pela ação do colchicina. Bol. Téc. Inst. Agron. Norte [Belém] **7:** 1–60. 27 Je 1946.

Pearson, Norma L. Observations on seed and seed hair growth in *Asclepias syriaca* L. Am. Jour. Bot. **35:** 27–36. *f. 1–22.* Ja [F] 1948.

Puri, V. Studies in floral anatomy. IV. Vascular anatomy of the flower of certain species of Passifloraceae. Am. Jour. Bot. **34:** 562–573. *f. 1–6.* D 1947 [4 F 1948].

Reeve, R. M. The "tunica-corpus" concept and development of shoot apices in certain dicotyledons. Am. Jour. Bot. **35:** 65–75. *f. 1–26.* Ja [F] 1948.

Ritchie, Don. The formation and structure of the zoospores in *Allomyces.* Jour. Elisha Mitchell Soc. **63:** 168–205. *pl. 22–26.* D 1947.

Tjio, Joe Hin. The somatic chromosomes of some tropical plants. Hereditas **34:** 135–146. *f. 1, 2.* 23 Ja 1948.

Wang, F. H. Life history of *Keteleeria.* I. Strobili, development of the gametophytes and fertilization in *Keteleeria evelyniana.* Am. Jour. Bot. **35:** 21–27. *f. 1–38 + table 1.* Ja [F] 1948.

GENETICS

(including cytogenetics)
(See also under Spermatophytes: **Gustafsson**)

Anderson, Edgar. Field studies of Guatemalan maize. Ann. Mo. Bot. Gard. **34:** 433–467. N 1947.

Atchison, Earlene. Cytogeography of *Gleditsia* and *Mitchella.* Jour. Hered. **38:** 311, 312. *f. 9.* O 1947 [Ja 1948].

Barton, Lela V. Effect of different storage conditions on the germination of seeds of *Cinchona Ledgeriana* Moens. Contr. Boyce Thompson Inst. **15:** 1–10. O–D 1947 [F 1948].

Cameron, James W. Chemico-gemetic bases for the reserve carbohydrates in maize endosperm. Genetics **32**: 459–485. *pl. I–III* + *f. 1–3*, S [15 N] 1947.

Fuller, Thomas C. Effects of several sulfa-compounds on nuclear and cell divisions. Bot. Gaz. **109**: 177–183. *f. 1–18*. D 1947 [30 Ja 1948].

Hirsch, H. E. Cytological phenomena and sex in *Hypomyces solani* f. *cucurbitae*. Proc. Nat. Acad. **33**: 268–270. S 1947.

Kerns, K. R. & Collins, J. L. Chimeras in the pineapple. Jour. Hered. **38**: 323–330. *f. 1–6*. N 1947 [F 1948].

Kohler, George W. *et al.* Selection and breeding for high β-carotene content (provitamin A) in tomato. Bot. Gaz. **109**: 219–225. D 1947 [30 Ja 1948].

Langham, D. G. Genetics of *Sesame*. V. Some morphological differences of the sesame flower (*S. indicum* L.). Jour. Hered. **38**: 347–352. *f. 14–16*. N 1947 [F 1948].

Mangelsdorf, Paul C. The inheritance of amylaceous sugary endosperm and its derivatives in maize. Genetics **32**: 448–458. *f. 1, 2*. S [15 N] 1947.

Mehlquist, Gustav A. L. Polyploidy in the genus *Paphiopedilum* Pfitz. (*Cypripedium* Hort.), and its practical implications. Mo. Bot. Gard. Bull. **35**: 211–225. *f. 1–7* + *tables 1, 2* + *chart 1, 2*. D 1947.

Ware, J. O., Benedict, L. I. & Rolfe, W. H. A recessive naked-seed character in upland cotton. Jour. Hered. **38**: 313–320. *f. 10, 11*, O 1947 [Ja 1948].

PLANT PHYSIOLOGY

(See also under Fungi and Lichens: **Barnett & Lilly**; under Spermatophytes: **Larsen**; under Phytopathology: **Ergyle**)

Bernstein, Leon & Thompson, John F. Studies on the carotene-destroying process in drying bean leaves. Bot. Gaz. **109**: 204–219. *f. 1–10*. D 1947 [30 Ja 1948].

Boatner, C. H. *et al.* Pigment glands of cottonseed. III. Distribution and some properties of cottonseed pigments. Bot. Gaz. **109**: 108–120. *f. 1–3*. D 1947 [30 Ja 1948].

Buell, Caroline B. & Weston, William H. Application of the mineral oil conservation method to maintaining collections of fungous cultures. Am. Jour. Bot. **34**: 555–561. *f. 1* + *table 1*. D 1947 [4 F 1948].

Burton, Daniel F. Formative effects of certain substituted chlorophenoxy compounds on bean leaves. Bot. Gaz. **109**: 183–194. *f. 1–6*. D 1947 [30 Ja 1948].

Chao, Marian Dellers & Loomis, W. E. Temperature coefficients of cell enlargement. Bot. Gaz. **109**: 225–231. D 1947 [30 Ja 1948].

De Ropp, R. S. The growth-promoting action of bacteria-free crown-gall tumor tissue. Bull. Torrey Club **75**: 45–50. *tables 1–4*. 29 Ja 1948.

Edwards, George A., Buell, Caroline B. & Weston, William H. The influence of mineral oil upon the oxygen consumption of *Sordaria fumicola*. Am. Jour. Bot. **34**: 551–555. *f. 1–4*. D 1947 [4 F 1948].

Goodwin, Richard H. & Kavanagh, Frederick. Fluorescing substances in roots. Bull. Torrey Club **75**: 1–17. *f. 1–5* + *tables 1, 2*. 29 Ja 1948.

Goodwin, Richard H. & Owens, Olga v. H. An action spectrum for inhibition of the first internode of *Avena* by light. Bull. Torrey Club **75**: 18–21. *f. 1*. 29 Ja 1948.

Gottlieb, David & Anderson, H. W. The respiration of *Streptomyces griseus*. Science **107**: 172, 173. 13 F 1948.

Hausman, Ethel Hinckley. Measurements of the annual growth-rate of two species of rock lichens. Bull. Torrey Club **75**: 116, 117. *table 1*. 29 Ja 1948.

Kelly, Sally. The relationship between respiration and water uptake in the oat coleoptile. Am. Jour. Bot. 34: 521–526. *f. 1–4 + tables 1–4.* D 1947 [4 F 1948].

Penfound, William T. & Minyard, Virginia. Relation of light intensity to effect of 2, 4-dichlorophenoxyacetic acid on water hyacinth and kidney bean plants. Bot. Gaz. **109:** 231–234. D 1947 [30 Ja 1948].

Sivori, Enrique M. Fotoperiodismo de *Chenopodium Quinoa* Willd.—Reacción de la cigota y gametófito femenino. Darwiniana **7:** 541–551. 17 S 1947.

Stewart, W. S. & Klotz, L. S. Some effects of 2,4-dichlorophenoxyacetic acid on fruit-drop and morphology of oranges. Bot. Gaz. **109:** 150–162. *f. 1–7.* D 1947 [30 Ja 1948].

Stuhlman, Otto. A physical analysis of the opening and closing movements of the lobes of the Venus' fly-trap. Bull. Torrey Club **75:** 22–24. *f. 1–13.* 29 Ja 1948.

Tam, R. K. Comparative herbicidal value of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid on some herbaceous weeds, shrubs, and trees under Hawaiian conditions. Bot. Gaz. **109:** 194–203. *f. 1–3.* D 1947 [30 Ja 1948].

Taylor, D. L. Effects of 2,4-dichlorophenoxyacetic acid on gas exchange of wheat and mustard seedlings. Bot. Gaz. **109:** 162–176. *f. 1–3.* D 1947 [30 Ja 1948].

Texera, Diego A. Production of antibiotic substances by *Fusaria.* Phytopathology **38:** 70–81. *tables 1–5.* Ja 1948.

Tiedjens, V. A. Relationships of ampholytes to assimilation and recovery of ammonium and nitrate nitrogen in plant tissue. Bot. Gaz. **109:** 95–107. *f. 1–6.* D 1947 [30 Ja 1948].

Westergaard, Mogens & Mitchell, Herschel K. *Neurospora* V. A synthetic medium favoring sexual reproduction. Am. Jour. Bot. **34:** 573–577. *f. 1 + tables 1–6.* D 1947 [4 F 1948].

Whitford, L. A. A study of some algal pigments. Jour. Elisha Mitchell Soc. **63:** 135–162. *f. 1–3.* D 1947.

Zimmerman, P. W. & Hartzell, Albert. Hexaethyl tetraphosphate and tetraethyl pyrophosphate: I. Their effects on plants. II. Their toxicities to insects and mites. Contr. Boyce Thompson Inst. **15:** 11–19. *f. 1 + tables 1–3.* O–D 1947.

GENERAL BOTANY
(Including Biography)

Acuña, Julián. Datos biográficos del Dr. Juan Tomás Roig y Mesa. Revista Soc. Cub. Bot. **4:** 4–8. Ja–Mr 1947.

Bailey, Liberty Hyde. Botanical sciences and their applications, including agriculture. Proc. Am. Philos. Soc. **91:** 22–26. 1947.

Chardon, Carlos E. La contribución del doctor Roberto E. Fries a los estudios botánicos del Nuevo Mundo. Darwiniana **7:** 497–503. *port.* S 1947.

Dodge, B. O. Robert Almer Harper. Proc. Linn. Soc. **158:** 134–136. 29 Jl 1947.

Ferreira Reis, A. C. O Jardin Botánico de Belém. Bol. Mus. Nac. [Rio de Janeiro] **7:** 1–14. 1946.

Flowers, Seville. A visit with Dr. Grout. Bryologist **50:** 208–212. *f. 1, 2.* Je [Jl] 1947.

Freeman, Grace Gibson. Knowing plants vs. knowing their names only. Castanea **12:** 74–76. S [N] 1947.

Harvey, Athelstan George. Douglas of the fir, a biography of David Douglas, botanist. *i–x*, 1–290. *illust.* Harvard Univ. Press. Cambridge. 1947.

Hawkes, J. G. La historia de la papa. Bol. Soc. Venez. Ci. Nat. **10:** 383–394. O–D 1946.

Hawkes, J. G. On the origin and meaning of South American Indian potato names. Jour. Linn. Soc. **53:** 205–250. 20 O 1947.

Higbee, E. C. *Lonchocarpus*—a fish-poison insecticide. Econ. Bot. **1:** 427–436. *f. 1–7.* 1947.

Karper, R. E. & Quinby, J. R. Sorghum—its production, utilization and breeding. Econ. Bot. **1:** 355–371. *f. 1–10.* O–D 1947.

Lombard, Frances F. Review of literature on *Cinchona* diseases, injuries, and fungi. U. S. Dep. Agr. Bibliogr. Bull. **9:** 1–70. D 1947.

Mayr, Ernst. Ecological factors in speciation. Evolution **1:** 263–288. D 1947.

Miller, William Hubert. Mark Catesby, an eighteenth century naturalist. Tyler's Quart. Hist. & Geneal Mag. **29:** 167–180. Ja 1948.

Munz, Philip A. A short history of the Rancho Santa Ana Botanic Garden. 1–31. *illust.* Los Angeles. M 1947.

Ponce de Leon, Antonio. El Hermano León. Revista Soc. Cub. Bot. **3:** 148–151. N–D 1946.

Quintana, Raúl. Breve resena sobre botánica americana. 1–52 *illust.* Buenos Aires. 1945.

Riquelma Inda, Julio. Los naturalistas en la provincia. Revista Soc. Mex. Hist. Nat. **7:** *1–6.* D 1946.

Roak, R. C. Some promising insecticidal plants. Econ. Bot. **1:** 437–445. *f. 1–3.* 1947.

Schnooberger, Irma. Moss Rock Cabin [and Dr. Grout]. Bryologist **50:** 213–217. Je [Jl] 1947.

Schuster, C. E. Edible nuts of the Pacific northwest. Econ. Bot. **1:** 389–393. *f. 1–3.* 1947.

Sparn, Enrique. Cronología, diferenciación, matrícula y distribución geográfica de las sociedades botánicas. Bol. Acad. Nac. Cienc. [Córdoba] **36:** 1–24. 1942.

Spencer, Claude F. *et al.* Survey of plants for antimalarial activity. Lloydia **10:** 145–174. *table 1.* S [O] 1947.

Stearn, William T. Endlicher's "Genera Plantarum," "Inconographia Generum Plantarum" and "Atakta Botanika." Jour. Arnold Arb. **28:** 424–429. 15 O 1947.

Stevens, Neil E. Factors in botanical publication and other essays. Chron. Bot. **11:** 122–204. 1947.

Tiffany, Lewis Hanford. Edmund Ware Sinnott: President of AAAS, 1948. Science **107:** 1. 2 Ja 1948.

Waller, Adolph E. Daniel Drake as a pioneer in modern ecology. Ohio St. Arch. & Hist. Quart. **56:** 362–373. O 1947.

Weatherby, C. A. Robert A. Ware. Am. Fern Jour. **37:** 65–67. *pl. 2.* Jl–S [O] 1947.

Wolf, Frederick A. & Wolf, Frederick T. The origin of tobaccos of the oriental type. Bull. Torrey Club **75:** 51–55. *f. 1–3.* 29 Ja 1948.

Woodward, E. F. Botanical drugs—a brief review of the industry with comments on recent developments. Econ. Bot. **1:** 402–414. *f. 1–4.* 1947.

Youngken, H. W. Ergot—a blessing and a scourge. Econ. Bot. **1:** 372–380. *f. 1–6.* 1947.

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THE MORPHOLOGY AND SYSTEMATICS OF THE WEST INDIAN MAGNOLIACEAE

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In the course of botanical field work in the Caribbean over the past 10 years, I have had the opportunity to observe, collect, and compare various native Magnoliaceae in flower and fruit. From this it becomes evident that there is considerable confusion in the application of botanical terms to the organs of the shoots and the flower as evidenced in the literature on the family. It also was found that an accurate description of the stamen structure was lacking and the most remarkable method of pollen distribution in the West Indian Magnolias had not been reported. The following discussion is based on field studies as well as an examination of the herbarium material cited in this paper.

The known Magnoliaceae present in the West Indies consists of eight native and one introduced species of *Magnolia*, three native species of *Talauma*, and two introduced species of *Michelia*.

Habit. Without exception the native Magnoliaceae in the Caribbean area are trees. Several local floras report Magnoliaceae as shrubs but these descriptions apparently are based on young plants of *Michelia* introduced within recent years. The native *Talauma dodecapetala* according to Stehlé and Marie lives to be over 100 years of age and is a very large tree in the Lesser Antilles. Trees of *Magnolia cubensis* seen in Cuba were up to 13–20 m. tall and other species of *Magnolia* seen in Hispaniola were trees 8–20 m. tall. Trunk diameters of 25–75 cm. have been reported for *Talauma* and *Magnolia* and the dark heartwood is valued as a timber. All information available reports the wood as hard and difficult to work but taking a beautiful finish as cabinet wood and generally immune to insect attacks.

Leaves. The leaves of all native members of the Magnoliaceae are alternate and petiolate, persisting for several seasons. The blades are thin- to thick-coriaceous and evergreen. The leaves are not crowded near the tips of the branches as has been reported in some species of *Magnolia* in southeastern United States, Mexico, and Central America.

Species of *Talauma* show considerable variation in leaf size and shape. Stehlé and Marie report distinct conditions of juvenile and mature leaves in *Talauma dodecapetala*. The leaves of the young plants or saplings are large, 40–45 cm. long and 12 cm. broad, and variable in shape, while the leaves of older trees, those usually seen on herbarium material, are smaller,

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18–20 cm. × 14 cm., and uniform in shape. Leaf variation in *Talauma minor* from eastern Cuba is great even in the leaves of flowering branches (fig. 26) and it is possible that material called *T. truncata*, known only from one sheet and in sterile condition, is but an extreme variation of *T. minor*.

No juvenile leaves have been described in the genus *Magnolia*. Young plants which I have seen in the field had little variation in size or shape of leaves from obvious saplings and from mature flowering trees. Leaves of species of *Magnolia* from Puerto Rico have an acute apex, and all the species reported from Hispaniola have leaves rounded or emarginate at the apex. In the Hispaniolan species, *Magnolia emarginata* and *M. Hamori*, the leaves are distinctly emarginate or even bilobed at the apex. The lobes are uniform in size and shape in *M. emarginata* while in *M. Hamori*, (fig. 1) one lobe is conspicuously smaller than the other. I have examined numerous leaves from one tree and those of several trees and this asymmetry of leaf lobes is a stable character in *M. Hamori*. The other Hispaniolan species with rounded apices commonly have an obtuse apiculum (fig. 33).

Pubescence. The presence or absence of pubescence on the young branches, leaves, and fruit is a diagnostic character in the genus *Magnolia* in the Caribbean area. The very young terminal leaves are often very densely pubescent, but as these leaves enlarge the hairs are more widely spaced and so the pubescence is less conspicuous. The oldest leaves may appear to be glabrate but close examination will show broken hairs or the bases of hairs on the epidermis.

The carpels are pubescent only in *Magnolia domingensis* (fig. 34), the pubescence persisting even in the mature and open fruit. Carpels of the other known species are completely glabrous.

Stipules. Large, usually connate stipules surround the stems in the Magnoliaceae.

In the West Indian species of *Talauma* and in the introduced species of *Michelia*, the stipules are characteristically adnate to the petiole (fig. 26). The stipules are deciduous very early but a scar is always evident around the branch and on the petiole. The petiolar scar increases in length with the developing petiole and often becomes a broken or irregular corky mass. On mature petioles the scar is seen as two corky ridges almost the length of the petiole (fig. 26) and running together at the apex in a large corky protuberance. The ridges and the protuberance have been erroneously interpreted as glands by some recent authors. The stipules of the vegetative shoots are elongate on the terminal buds and extend to an acuminate apex. In the lateral buds the stipules are much smaller and the apex is rounded (fig. 17). The fusion of the two stipules is usually complete and rupture is irregular. A distinct vascular midvein is evident opposite the line of dehiscence. Stipules may be glabrous or with a persistent pubescence.

In the West Indian species of *Magnolia* (fig. 36) the stipules are completely free from the petiole but morphologically are similar to those of *Talauma* and *Michelia*, described above.

Flowers and the Floral Axis. *Michelia*, introduced and widely cultivated in the West Indies, has axillary flowers with several flowers simultaneously present on a shoot. *Talauma* and *Magnolia* usually have terminal solitary flowers but occasionally a second flower will be developed from a lateral bud on this flowering shoot (fig. 26). I can not tell from the material on hand if this is a condition of second flowering, as has been reported in *Magnolia Soulangeana* in cultivation and in *Liriodendron Tulipifera*, or whether several flowers may be present at one time.

In *Talauma minor* the flower is borne on a short stalk, commonly called the peduncle. Two foliaceous organs, called bracts or prophylls by various authors, surround the flower and within these foliaceous organs is another short stalk, commonly called pedicel, supporting the flower. The perianth segments, stamens and carpels are terminal on this axis. The same condition is true in the West Indian species of *Magnolia* (fig. 2).

I have preserved in alcohol several hundred flowers, all from one tree, of *Magnolia Hamori*. Careful study of these flowers shows that the foliaceous organs surrounding the flower bud are stipules adnate to an elaminate petiole and there should no longer be any question of their nature or origin. In the vast majority of these preserved flowers the foliaceous bracts surrounding the flowers are spathe-like, entire, completely connate, and slightly acuminate at the apex. Dehiscence occurs regularly along one side and is even and straight (fig. 8). In a few flowers a strong ridge is developed on the side opposite the line of dehiscence, frequently terminating in a free appendage (figs. 7, 8, 13). The spathaceous sheath of the flower bud is deciduous in three parts. It is obvious that the spathaceous sheath surrounding the flower is a leaf with two foliaceous stipules. In most cases the leaf was reduced to an elaminate petiole but in a few specimens a small lamina was developed of the same characteristic shape and with the same asymmetrically bilobed apex as the mature vegetative leaves (fig. 2). It is clear, therefore, that the terminal flower of *Magnolia Hamori* with its spathaceous bract and the stalked flower within this bract represents a reduced branch, with at least one leaf node on the floral axis. In a leaf on the vegetative shoot the stipules are completely free from the leaf and petiole. On the floral axis, however, the leaf, or the elaminate petiole, is adnate to the spathe-like stipules which surround the flower. If the leaf of the floral axis develops a blade the leaf remains on the axis for some time, persisting in the fruiting condition at least, and the petiole of this leaf shows definite stipular scars terminated at the apex of the petiole by a larger mass of scar tissue. In the Magnoliaceae a condition of adnate

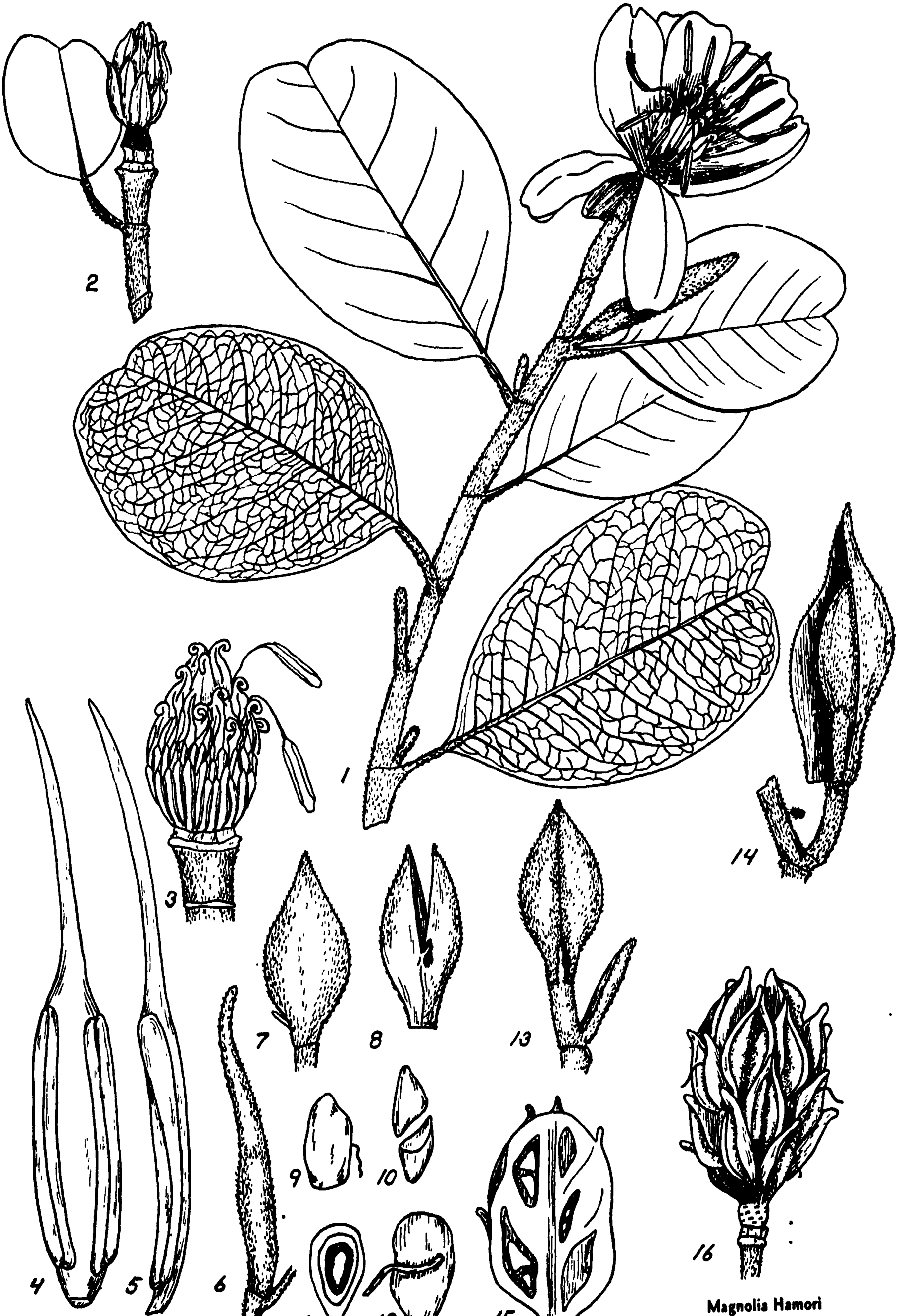
stipules as in *Talauma* and *Michelia* is considered to be primitive, and free stipules, as in *Magnolia*, an advanced character. A lack of stipules would be even more advanced but such a condition does not exist in this family as now generally defined. Thus *Magnolia Hamori* shows a more primitive condition in the stipules of the floral axis than in the vegetative shoot.

It is worth noting that the internodes of the floral branch in *Magnolia* are not much shorter than those of the vegetative shoots. Quite the opposite situation can be observed in *Talauma minor* (fig. 26) where several short internodes and several leaf nodes occur immediately below the flower. The leaves from this axis are probably all small and dehisce quickly. I do not know if these leaves have sheathing stipules forming a series of spathaceous bracts around the floral axis but I strongly suspect that may be the case. Two bracts, one enclosing the other, were found by Dandy in *Magnolia yoroconte* and reported in the *Journal of Botany* **68**: 147 (1930). It may be suggested therefore, that the floral branch of *Talauma*, as indicated by *T. minor* with several internodes below the flower, is more primitive than that of *Magnolia* with only two internodes below the flower.

The perianth segments are usually undifferentiated into calyx and corolla although the outer segments may be of different shape and texture than the inner segments. The inner segments, called petals in the current literature, vary in number from 6 to 9. They may be larger or smaller than the outer segments and this variation will be found in numerous flowers on one tree. Size, shape, and number of perianth segments is not a stable character in the West Indian Magnoliaceae.

Explanation of figures 1–16

Magnolia Hamori. FIG. 1. Habitat, × ½. FIG. 2. Floral axis with young fruit, × ½. The first node below the perianth shows a small leaf developed from the petiolar portion of the spathaceous bract. Stipules have fallen but stipular scar on the petiole is evident. FIG. 3. Flower with the perianth removed to show the position of the stamens, × ½. Two stamens have dehisced from the androphore and are held by the setaceous connective tips imbedded in the gynoecium. FIG. 4. Inside view of a stamen, × 4. FIG. 5. Lateral view of a stamen, × 4. FIG. 6. Terminal bud enclosed in sheathing stipules showing the free petiole of the leaf, × 1. FIG. 7. View of spathaceous bract around the flower showing the free appendage at the apex of the petiole. × ½. FIG. 8. Spathaceous bract after it has fallen from the flower showing free apex of the petiole. Note that dehiscence of the individual stipules is not limited to one side of the bract. × ½. FIG. 9. Oblong seed developed singly in a carpel, × 1. A portion of the funicle remains attached to the seed. FIG. 10. Triangular compressed shape of seeds when two are developed in a carpel, × 1. FIG. 11. Diagrammatic cross section of a seed showing two layers of the seed coat. The outer coat is fleshy and rich in an aromatic oil. The inner seed coat is lignified. FIG. 12. The lignified inner seed coat wth the fleshy outer coat removed to show the transverse path of the ovule vascular bundle to the chalazal opening in the inner seed coat, × 1. FIG. 13. Floral axis before the dehiscence of the spathaceous bract, × ½. FIG. 14. Flower bud showing two enclosing spathaceous bracts, × 1. FIG. 15. Diagrammatic longitudinal section of a young fruit. FIG. 16. Mature fruit showing the occasional complete dehiscence of the woody carpel along both inner and outer sutures, × ½.



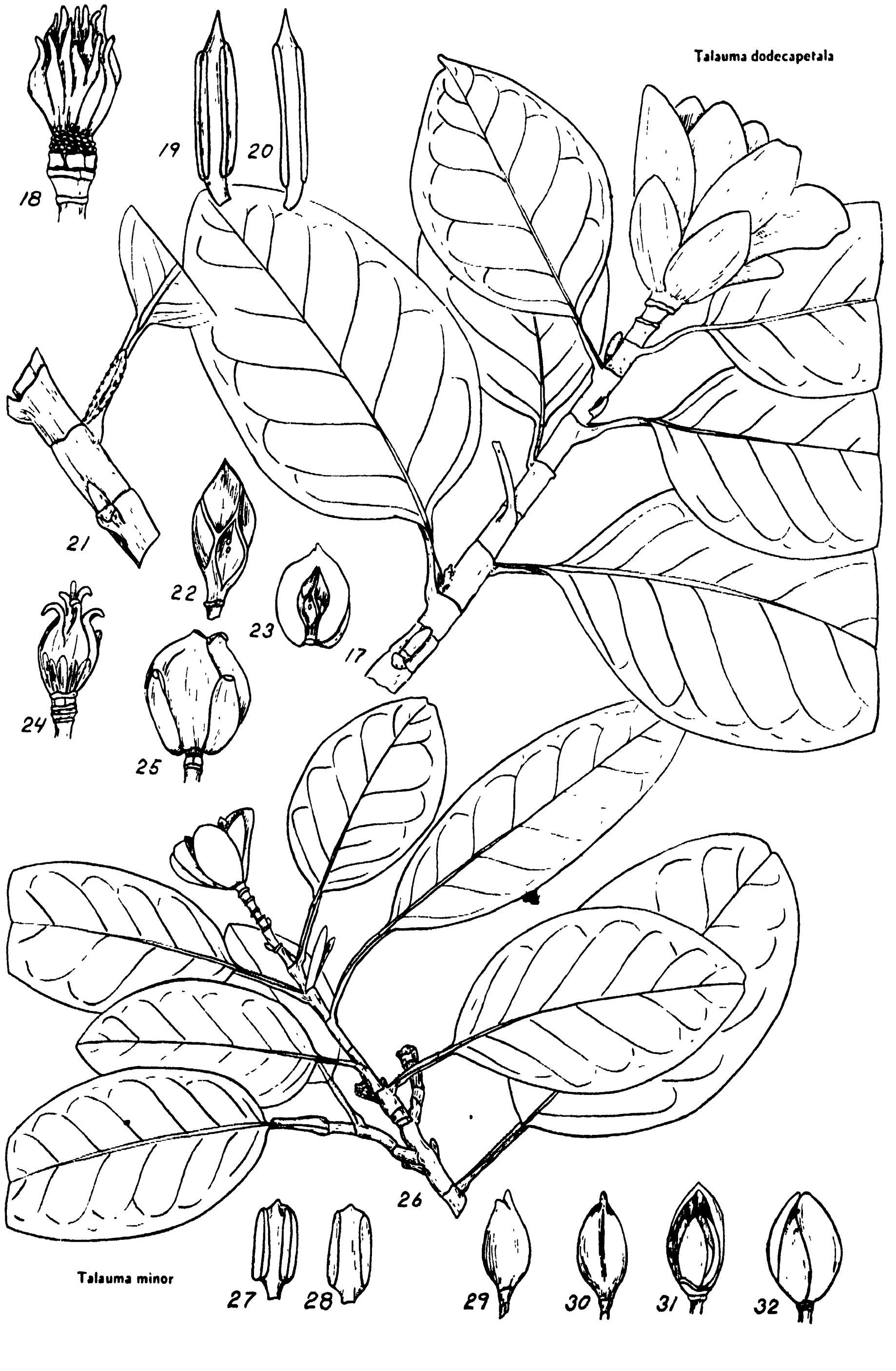
Magnolia Hamori

The stamens and the method of release of pollen in the West Indian species of *Magnolia* are interesting and worthy of special attention. The stamens in *Magnolia* are always numerous. The portion of the axis bearing the stamens is called the androphore; little variation was found in the length of the androphore in the various species studied.

The filament of the stamen is always short and fleshy (figs. 4, 5) and the anther has elongate lateral thecae which dehisce introrsely. The thecae are well separated for all of their length by a mass of fleshy tissue called the connective. At the apex of the anther in the native West Indian species the connective is produced into a setaceous tip, which is usually about the length of the thecae (figs. 4, 5). The presence of this setaceous tip is a distinctive character of the West Indian species and sets them off as a subsection of the section *Theorhodon* in *Magnolia*. The setaceous tip has a very important role in the distribution of pollen in this group of species. In the flower bud the connective tips are forced against the gynoecium and soon become firmly embedded in the fleshy gynoecial tissue or are caught between the carpels and held there. It is almost impossible to extract these tips from the gynoecial tissue in fresh or properly preserved material. This is not a fortuitous condition nor a drying factor and has been seen in every native West Indian species known in flowering condition. When the flower opens the stigmas appear to be receptive. They are turgid, covered with plump papillae and glisten when fresh. As the perianth continues to expand the stamens dehisce from the main axis but are held within the flower by the setaceous tips which now are embedded in the gynoecium (fig. 3). The stamens, then reversed in position, extend beyond the perianth, still held by the connective tips embedded in the gynoecium, so that, in lateral view of the flower, the stamens appear to be exserted beyond the perianth. It is in this position, exterior to the perianth, that the thecae open and the pollen is shed. This is certainly advantageous for the distribution of pollen. At this stage the stigmas have shrunken and are almost dry, so by proper timing of release of pol-

Explanation of figures 17–32

Figs. 17–21. *Talauma dodecapetala*. FIG. 17. Habit, × ⅓. FIG. 18. Gynoecium, × ⅓. FIG. 19. Inside view of the stamen showing the extension of the connective into an acute tip, × 1.5. FIG. 20. Lateral view of the stamen, × 1.5. FIG. 21. Portion of a stem and leaf to show the corky stipular sear on the petiole, × ½. Figs. 22–32. *Talauma minor*. FIG. 22. The woody fruiting axis after the circumscissile dehiscence of the woody carpels, × 1. FIG. 23. Fruit with several carpels already dehisced showing the thickness of the remaining carpel wall, × ½. FIG. 24. Floral axis with perianth removed, × ¾. FIG. 25. Mature fruit, × 1. FIG. 26. Habit, × ⅜. FIG. 27. Inside view of a stamen, × 4. FIG. 28. Lateral view of a stamen, × 4. FIGS. 29–30. Two views of the flower bud with the spathaceous bract present. Note the vascular (petiolar) ridge in fig. 30, and the free terminal appendage of the petiole, × ½. FIG. 31. Flower bud with portion of the spathaceous bract removed, × ½. FIG. 32. Flower after dehiscence of the spathaceous bract, × ½.


Talauma dodecapetala
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Talauma minor
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len self-pollination is prevented. Eventually the setaceous connective tips break and the stamens are shed.

The long setaceous extensions of the connective are found neither in species of *Talauma* nor in *Michelia*. Instead, in these, the connective is rounded or slightly acute beyond the thecae.

The gynoecium is sessile on the androphore in *Magnolia* and *Talauma*. A gynophore is developed in *Michelia* and the carpels, distinct and separated, are borne on an elongate axis. During the period of maturation of the fruit the axis in *Michelia* elongates still more, so that the mature fruit of *Michelia* is elongate and contorted with distinct fruiting carpels. Several to numerous ovules are found in each carpel of *Michelia* and several to numerous seeds are produced in each. The mature carpels are rounded and dehiscence takes place along a dorsal line.

In the two species of *Talauma* in the West Indies the carpels are fleshy and closely packed in the flower and become fused and woody in the fruit. The fruit of *Talauma dodecapetala* is large, 6–8 cm. diam., resembling in size and shape the cherimoya. This accounts for the species originally being described in the genus *Anona*. The carpels are circumscissile with large woody masses breaking from the mature fruit revealing the central woody core with well defined locules. The two seeds are pendant on long funiculi from this woody core. Only a few carpels, ca. 8, are found in *T. minor* and these are also fused. These carpels also dehisce in a circumscissile manner but individually or in groups of 2 or 3, and the two seeds of each locule remain attached to the central axis. Carpels in *Talauma* are more follicular than those of *Michelia* but less so than those of *Magnolia*.

In the West Indian species of *Magnolia* the carpels are closely packed in the gynoecium and remain so until the fruit is nearly mature. When mature, however, the woody carpels are clearly distinct and follicular with a well defined groove on the outer surface. The carpels open individually along this groove for their full length; however, if sufficient space is available between the carpels in the mature fruit dehiscence will take place along both the outer and inner sutures thus freeing both carpel walls. Two ovules are present in each locule and these are attached one above the other in a line on the inner margin of the carpel. Usually two seeds are developed although frequently only one matures. When the fruit opens the seeds are suspended by long funiculi and hang outside the fruit. The fruits in the West Indian species are uniformly well developed; rarely is the contortion so frequently seen in Asiatic species noticed in these species. This contortion is caused by the failure of many carpels to develop.

Seeds. In *Magnolia* the seeds have received considerable study because of their unusual structure. The fresh seeds are colorful, being pink, red

or orange. This color is in a fleshy layer called the outer seed coat and distinct from the inner lignified seed coat. Both seed coats are now known to have developed from the outer integument of the ovule, the inner integument being represented in the seed by a paper-thin membrane. A large amount of oily endosperm incloses the minute embryo. This endosperm is reported to contain over 50 per cent oil in some species. The embryo has small cotyledons and an undifferentiated plumule. The radicle is small and straight. An ovule vascular bundle runs transversely across the seed under the outer fleshy seed coat and on the surface of the woody inner seed coat where it enters the seed chamber through a large, well-defined chalaza or pore.

No seeds of *Talauma* or *Michelia* are available for study.

Germination. It has been noted by various authors that only a small percentage of the seeds of *Magnolia* are perfectly developed. Of the fruits examined in three West Indian species less than 30 per cent of the seeds are plump and fully developed. Germination of even perfectly developed seeds appears to be difficult because of the impermeable lignified inner seed coat. Very few seedlings or sprouted seeds can be found on the forest floor. This, however, is probably due to the nature of the seed coat, which has a strong aromatic principle and appears to be tasty to birds. The seeds are frequently eaten as soon as they appear outside of the fruit and are probably distributed by birds, which would account for the failure of *Magnolia* to form large stands in the tropics.

Various authors have reported resting periods of as long as one year for species outside the West Indies. I have obtained 100 per cent germination of plump seeds of the Hispaniolan *Magnolia Hamori* within three months of the time the seeds were collected. All these seeds were cut through the hard inner seed coat to check for plumpness of the endosperm and it is apparent that the woody inner seed coat would retard germination.

Chromosomes. Whitaker (Jour. Arnold Arb. **14**: 376. 1933) gives chromosome counts for several species of *Magnolia*, all from the United States or introduced species from Asia. The basic number in his counts is 19. Darlington and Janaki (Chromosome Atlas 1945) report the chromosome number of *Magnolia grandiflora* to be 114. This is the only one of their list occurring in the West Indies. Smears were made from the seedling material of *Magnolia Hamori* and a chromosome count of 38 was obtained, placing *M. Hamori* in the group of diploid species. The chromosomes are short and thick and there is some tendency for them to occur in pairs as Whitaker reported for several other species. The roots of the seedling material of *M. Hamori* were extremely delicate and no counts could be obtained from them. Only a little meristematic activity was seen

in the young leaves and that at the base of the lamina. Successful counts were made from smears of the apex of the stem and from lateral buds.

Material for this study has been borrowed from several herbaria and studied at other collections. The author is grateful to the curators of the following herbaria for the material sent on loan and for courtesies extended during the course of this survey: Arnold Arboretum (A), Field Museum (FM), Gray Herbarium (G), New York Botanical Garden (NY), Polytechnic Institute of Puerto Rico (PR), Riksmuseum of Stockholm, Sweden (S), the United States National Herbarium (US) and the Yale School of Forestry (Y).

For special assistance I am endebted to Mr. George Hamor of Barahona, Dominican Republic, for the preserved flowers and the mature wood of *Magnolia Hamori;* to Mr. James Canright of the Biological Laboratories of Harvard University for the description of the mature wood of *Magnolia Hamori;* to Dr. G. Erdtman of Stockholm for his analysis of the pollen grains of this family; and to Father Berger and Dr. Witkus of Fordham University for the chromosome count of seedling material of *M. Hamori.*

MAGNOLIACEAE

Trees; bitter aromatic principle present in bark and leaves; leaves alternate, entire, usually coriaceous, petiolate; stipules present, connate, surrounding the branches, fused to the petiole or free from it, early caducous; flowers axillary or terminal, large and showy, short-stalked, spathaceous bracts present; perianth segments in series of 3, hypogynous, deciduous; stamens numerous, anthers linear, introrsely dehiscent; gynophore present or wanting; carpels numerous, separate or cohering, 1-celled, ovules 1 or 2, to numerous; fruit coniform, woody carpels individually dehiscent, or adnate and irregular circumscissilely dehiscent; seeds 1 or 2 to several in each cell, borne on a long funicle; endosperm copious, embryo small.

Flowers axillary; gynophore present, elongate; carpels widely spaced on the axis, separating at maturity, dehiscent along a dorsal suture; seeds several; stipules adnate to the petiole. *Michelia.*

Flowers terminal; gynophore wanting, gynoecium sessile, carpels closely packed, not separating at maturity; seeds 1 or 2.

  Carpels essentially separate at maturity, each carpel dehiscent along a dorsal suture; stipules free from the petiole. *Magnolia.*

  Carpels fused, circumscissilely dehiscent, the upper portion falling away from the persistent basal portion individually or in irregular masses; stipules adnate to the petiole. *Talauma.*

MICHELIA L. Sp. Pl. 536. 1753. Trees; leaves evergreen, coriaceous, entire; stipules surrounding the branch, connate, adnate to the petiole for two-thirds its length, leaving a persistent two-ranked scar; flowers axillary, solitary, stipules spathaceous, connate around the bud, splitting irregularly

and persistent after anthesis of the flower; perianth segments similar, 9–15 in 3–several series, filaments short, anthers linear, connective slightly extended into an acute apex; gynophore present, carpels numerous, ovules 8–many in each locule, style short, spreading or recurved, free, deciduous; fruiting axis elongate, carpels separate, dehiscent on the dorsal margin, seeds several, hanging from elongate funiculi, outer seed coat fleshy, usually bright red, inner seed coat lignified, embryo small.

Leaves ovate-lanceolate to lanceolate-oblong, apex acuminate, base rounded to acute; branches and buds densely short-sericeous; carpels sericeous. *M. Champaca.*

Leaves obovate to obovate-oblong, apex acute, base narrowed or cuneate; branches and buds densely ferrugineous-sericeous with spreading hairs; carpels glabrous except for a few hairs at the base. *M. fuscata.*

MICHELIA CHAMPACA L. Sp. Pl. 536. 1753. Trees to 10 m. tall; branches short-sericeous becoming glabrate; leaf blades ovate-lanceolate to lanceolate-oblong, 11–24 cm. long, 6–9 cm. broad, glabrous above, sericeous below becoming glabrate, apex acuminate, base rounded or acute; petioles 3–4 cm. long, stipular scars 2 cm. long; flowers solitary in the axils, peduncle 7–10 mm. long, spathaceous bracts ovate, 2–2.5 cm. long, 1.5 cm. broad, pedicels 2–4 mm. long; perianth segments lanceolate, 3–4 cm. long, 1–1.2 cm. broad, yellow or white; stamens numerous, androphore 2–3 mm. long, filaments 2 mm. long, thecae linear, 4–5 mm. long, pollen grains monosulcate, large (*Bovell 80*) 40 μ long, 26 μ deep, 28 μ broad, exine not rough, connective produced into an acute apex 1 mm. long; gynophore 4–6 mm. long, gynoecium elongate, 1.5 cm. long at anthesis, carpels numerous, sericeous, styles spreading or recurved, 2–3 mm. long; fruit elongate, axis to 20 cm. long, mature carpels globose to oblong, 1–2 cm. long, 1–1.1 cm. broad, woody; seeds 5–10, 1 cm. long, 7 mm. broad, 3–4 mm. thick, outer seed coat red.

CUBA: Las Villas province, Soledad, *Jack 4523* (US), *5324* (NY, US) collected in fruit in Aug., *Jack 5393* (NY, US) collected in flower in June. BARBADOS: Dodds, *Bovell 80* (NY), in flower. GUADELOUPE: Pointe à Pite, *Questel 249* (US), *3889* (NY) in fruit in November. HAITI: Massif de la Selle, Petionville, *Ekman 9360* (US).

Local name: Banana shrub (Cuba, ex Jack).

A native of India widely planted in the American tropics as an ornamental tree.

MICHELIA FUSCATA (Andr.) Blume, Fl. Jav. Magnol. 8. 1828–26. *Magnolia fuscata* Andr. Bot. Repos. *pl. 229.* 1802; Sims, Bot. Mag. *pl. 1008.* 1807.

Small tree, 2 m. or more high; branches densely fuscescent-strigose or hispid becoming glabrate; leaf blades obovate to obovate-oblong, 5–7 cm. long, 2.5–4 cm. broad, glabrous above, sparsely strigose below becoming glabrate, apex acute, base narrowed or cuneate; petioles 3–4 mm. long, densely fuscescent-strigose, petiolar scar 1–2 mm. long; flowers solitary in the axils, peduncles 7 mm. long; spathaceous bracts 0.7–1 cm. long; pedicels 1–3 mm. long; perianth segments similar, 6–9, oblong to lanceolate-oblong, 1.5 cm. long, 5–7 mm. broad, yellow-white becoming orange in age, margins often reddish; stamens numerous, filaments 2 mm. long, thecae

linear, 3–4 mm. long, connective slightly produced beyond the thecae into an acute apex 0.1–0.2 mm. long; gynophore 6 mm. long, gynoecium 6–8 mm. long at anthesis, carpels numerous, glabrous or with a few hairs at the base, styles spreading, slightly recurved at the apex, 2 mm. long; fruit not represented among herbarium specimens available to me nor was the fruit described in the original publication of this species.

PUERTO RICO: Happy Hollow, *Britton 8083* (NY), in bud in February. BERMUDA: Cedar Lodge, *Brown, Britton & Bissett 2041* (NY) without flowers or fruit in May–June. A native of China.

For the dates of publication of Andrews' Botanists Repository cited above see the paper by J. Britten, Ann. Bot. **54**: 236 (1916).

MAGNOLIA L. Sp. Pl. 535. 1753.[1] Trees: leaves evergreen, coriaceous, entire, stipules ochrea-like, connate, completely free from the petiole, glabrous or pubescent; flowers terminal, solitary or rarely two, on a short peduncle, spathaceous bract present, surrounding the flower, glabrous or pubescent, coriaceous; pedicel wanting or developed; perianth segments similar or slightly different, outer segments 3, spreading or reflexed, inner segments 6–9, white or yellowish, spreading, often concave, glabrous; androphore short, stamens numerous, filaments short and fleshy, thecae linear, introrsely dehiscent, connective prolonged beyond the thecae into a short triangular apex or a long and setaceous tip; gynoecium sessile, carpels 9 to numerous, sessile, glabrous or pubescent, 1-celled, ovules 2 in each cell, style spreading and usually recurved at the apex, stigmatic on the inner surface; fruit coniform, symmetric through the high proportion of fertilized carpels, carpels dehiscent along the back or occasionally along both sutures, woody, seeds 1 or 2 in each cell, suspended by a long funicle, outer seed coat fleshy, red or orange, inner seed coat woody; endosperm copious, embryo minute, cotyledons short.

Position of the West Indian Magnolias. The native species of *Magnolia* in the West Indies, i.e. excluding *M. grandiflora* in the present treatment, belong in the section *Theorhodon* Spach (Hist. Nat. Veg. Phaner. 7: 470. 1839) which includes Magnolias from Central and South America as well as the West Indies. In this section the West Indian species are distinct as a subsection or a group. Mr. J. E. Dandy has indicated to me in correspondence that he will name this subsection in a future treatment of the genus *Magnolia*. The subsection, i.e. the West Indian species, here considered is a natural group of endemic species. The species have in common the extension of the connective beyond the thecae of the anther into a long setaceous or filamentous tip, and the tendency for the spathaceous bract (stipules of an elaminate petiole) to be located a short distance below the perianth on the woody axis of the flower stalk. Thus the woody axis supporting the flower consists of two internodes, the one below the bract is called the peduncle, the one between the bract and the perianth, the pedicel.

The West Indian species are primitive in the genus on several characters. The evergreen coriaceous leaves, the nature of the spathaceous bracts, the elongate stamens with the setaceous extension of the connective,

[1] This generic description applies only to the native West Indian species and to the introduced *M. grandiflora*.

the symmetric fruit with the high percentage of fertilized carpels and the general production of two seeds are considered primitive characters. That the stipules are free from the petiole and thereby leave the petiole unscarred is considered an advanced character in the genus, although the more primitive condition of stipules fused to the petiole is retained on the floral axis.

KEY TO THE WEST INDIAN MAGNOLIAS

Leaves acute or acuminate at the apex.
Stems and leaves pubescent.
Perianth segments 10–14 cm. long; connective extended beyond the thecae into a triangular apex 1–1.5 mm. long; carpels pubescent. *M. grandiflora.*
Perianth segments 3–4.5 cm. long; connective extended beyond the thecae into a setaceous tip to 10 mm. long; carpels glabrous. *M. splendens.*
Stems and leaves glabrous.
Leaves broadly oval; spathaceous bract 4 cm. long; carpels 20–25. *M. portoricensis.*
Leaves oblong to elliptic, rarely ovate; spathaceous bract 1.9 cm. long; carpels 5–8. *M. cubensis.*
Leaves rounded, apiculate or emarginate at the apex.
Stems pubescent; petioles and leaves pubescent, occasionally becoming glabrate.
Carpels pubescent; leaves becoming glabrate. *M. domingensis.*
Carpels glabrous.
Leaves rounded at the apex, densely and persistently pubescent on the lower surface. *M. pallescens.*
Leaves emarginate at the apex, the lobes strongly unequal, glabrous below except for the petiole and the base of the midrib. *M. Hamori.*
Stems glabrous.
Leaves obovate to obovate-orbicular, apex rounded or emarginate. *M. emarginata.*
Leaves oval, apex rounded or apiculate. *M. Ekmanii.*

MAGNOLIA GRANDIFLORA L. Syst. Nat. ed. 10. **2**: 1082. 1759.

Magnolia virginiana var. *foetida* L. Sp. Pl. 536. 1753.
Magnolia foetida Sarg. Gard. & For. **2**: 615. 1889.

Trees 15–25 m. tall; branches densely tomentose; stipules 4–5 cm. long, tomentose; leaf blades elliptic, oval, or oblanceolate, 10–25 cm. long, 5–13 cm. broad, coriaceous, glabrous above, densely ferrugineously tomentose below, becoming glabrate, apex acute or acuminate, base acute or rounded, petioles 2–4 cm. long, 3–4 mm. thick, tomentose; flowers terminal, solitary, peduncle 1–2 cm. long, spathaceous bracts not seen, pedicels scarcely developed or to 7 mm. long; outer perianth segments oblong to ovate, 7 cm. long, 3 cm. broad, inner perianth segments broadly ovate to obovate, 10–14 cm. long, 4–7 cm. broad, rounded at the apex, white; stamens numerous, androphore 1–1.5 cm. long, filaments 2 mm. long, thecae linear, 10–17 mm. long, connective extended beyond the thecae into a fleshy triangular apex 1–1.5 mm. long; gynoecium ovate, 3–4 cm. long, 1.5–2 cm. diameter at anthesis, carpels 40 to numerous, densely tomentose, styles recurved, 5–10 mm. long, glabrous; fruit oval to oblong, 7.5–10 cm. long, 4–6 cm. diameter, tomentose; seeds 2, or 1 in each carpel, obovoid to triangular-obovoid, 1–1.5 cm. long, 7–9 mm. broad, 3–5 mm. thick, outer seed coat orange to bright red.

PUERTO RICO: Trujillo Plant Station, *Britton without number*, (NY) Nov. 1933, in sterile condition. DOMINICAN REPUBLIC: Sanchez, *Ekman 15954* (S), in sterile condition in August.

Magnolia grandiflora is considered a native of southeastern United States. The population is extremely diverse and has been divided into several varieties. Since the chromosome count is 114 it is a high polyploid (hexaploid) population and extremely complex. The species needs careful field study and a thorough cytological examination.

MAGNOLIA SPLENDENS Urb. Symb. Ant. **1**: 306. 1899; **4**: 238. 1905; Britton & Wilson, Sci. Surv. Porto Rico **5**: 309. 1924.

Talauma mutabilis var. *splendens* Urb. ex McLaughlin, Trop. Woods **34**: 36. 1933.
Talauma splendens (Urb.) McLaughlin, Trop. Woods **34**: 36. 1933.

Trees, 5–25 m. tall; branches sericeous-pilose; stipules 4–9 cm. long, densely sericeous; leaf blades ovate to ovate-elliptic, 10–18 cm. long, 4.5–9 cm. broad, coriaceous, persistently and densely sericeous-pilose below, glabrous above, apex acute or acuminate, base rounded; petioles 1.5–3 cm. long, 1.5 mm. thick, sericeous-pubescent; flowers terminal, solitary or two together, 2–3 cm. broad, densely sericeous-pubescent, pedicels 4–6 mm. long, outer perianth segments obovate-oblong, 3–3.5 cm. long, 1.5–2.5 cm. broad, inner perianth segments obovate, 3–4.5 cm. long, 2.5–3.5 cm. broad, rounded at the apex; stamens numerous, androphore 2–3 mm. long, filaments 1–1.5 mm. long, thecae linear, 10 mm. long, pollen grains monosulcate, large (*Eggers 1281*) 72 μ long, 36 μ deep, 46 μ broad, exine not very rough, connective produced beyond the thecae into a setaceous tip 5 mm. long; gynoecium oblong, 1–1.3 cm. long, 7–8 mm. broad at anthesis, carpels 15–18, glabrous, styles spreading and recurved, 3 mm. long; fruit oblong, 3.5 cm. long, 2 cm. diameter at maturity; seeds 2, oblong or triangular, 7 mm. long, 5 mm. broad, 3 mm. thick, outer seed coat red.

PUERTO RICO: Sierra de Luquillo: Jimines Mts. *Eggers, ed. Toepff. 1070* (TYPE, not seen), *1281* (US) in flower May 1883; *Sintenis 1423* (FM, G, S, US) in flower June 1885; *Kramer 28* (US) sterile in April; El Yunque, La Mina, *Otero 671Z* (FM); Sierra de Naguabo, Los Ranchones, *Sintenis 5324* (FM, G, NY, S, US) fruit in Oct. 1866; Barrio de Maizales, *Britton & Hess 2303* (NY) in sterile condition March 1914 at 950 m. alt; without locality, *Cowles 440* (US) in flower April 1913.

Local names: Sabino, Laurel sabino.

McLaughlin's decision to transfer *M. splendens* to the genus *Talauma* on the basis of its wood structure is not supported by characters in the flowers or the fruits. McLaughlin does not cite the material he examined in reaching this conclusion and there is no annotated material in the Yale collection to indicate what he might have had.

MAGNOLIA PORTORICENSIS Bello, Anal. Soc. Esp. Hist. Nat. **10**: 233. 1881; Stahl, Est. **2**: 22. 1884; Urban, Symb. Ant. **1**: 307. 1899; **4**: 238. 1905; Britton & Wilson, Sci Surv. Porto Rico **5**: 309. 1924.

Trees, 8–25 m. tall; branches glabrous; stipules 3–5.5 cm. long, glabrous; leaf blades broadly oval to slightly obovate, 8–24 cm. long, 6–13 cm. broad, coriaceous, glabrous, apex acute and abruptly short-cuspidate, strongly curved and conduplicate, base rounded, petioles 2–2.5 cm. long, 2–2.5 mm. thick, glabrous; flowers terminal, solitary, peduncle 1 cm. long, spatha-

ceous bract 4 cm. long, 5 cm. broad, glabrous, coriaceous, pedicel 5 mm. long; outer perianth segments greenish, concave, 4 cm. long, 2.5 cm. broad; inner perianth segments ovate, 3–4.5 cm. long, 3.5 cm. broad, obtuse at the apex; stamens numerous, androphore 2.5 mm. long, filaments 1 mm. long, thecae linear, 10 mm. long, pollen monosulcate, large (*Sintenis 4400*), 83 μ long, 51 μ deep, 58 μ broad, exine rough, connective produced into a stout fleshy apex 3–8 mm. beyond the thecae; gynoecium ovate, 2 cm. long, 1.4 cm. diameter at anthesis, carpels 20–25, glabrous; fruit oblong, 3.5 cm. long, 2.5 cm. diameter, seeds 2, outer seed coat red-orange.

PUERTO RICO: Penuelas, Cruces, *Sintenis 4400* (FM, G, NY, S, US) in flower in May; Adjuntos, Mt. Bajaza, *Sintenis 4271* (G, US), sterile in April; Jayagua, San Pabricio, *Sintenis, without number* (G), in flower in June; Monte Algerillo, *Stevens 4733* (NY), in fruit in Nov.; Rubias, north of Yauco, *Britton & Britton 7362* (NY), in fruit in Feb. at 800 m. alt.; Cerro Gordo, moist forest at 1000 m. alt. *Velez 1512* (PR), in flower in June, *Velez 1633* (PR), in flower in May; Maricao Insular Forest, *Velez 1111* (PR), in flower in April.

Local names: Burro, Mauricio, Jaqilla.

No specimen is mentioned by number in the original description, and I have not seen any material collected by Bello. In Stahl's description of *M. portoricensis* the original description published by Bello is repeated and the "petals" are described as "6 cm. long." All recent collections of this species have much shorter perianth segments.

MAGNOLIA CUBENSIS Urb. Symb. Ant. **1**: 307. 1899. Fig. 36. Tree to 17 m. tall; branches glabrous; stipules 2.5–3.5 (7) cm. long, glabrous; leaf blades oblong to elliptic, rarely slightly ovate, 8–12 cm. long, 3.5–5 (7) cm. broad, glabrous, coriaceous, often shining on both surfaces, apex acute or acuminate, base acute or rounded; petioles 1.4–2.2 cm. long, 1 mm. thick, glabrous; flowers terminal, peduncle 1–1.5 cm. long, spathaceous bract 2 cm. long, 2.5 cm. broad, pedicel 3 mm. long; outer perianth segments obovate, 3 cm. long, 2 cm. broad, apex rounded; inner perianth segments obovate, 2–3 cm. long, 1–1.8 cm. broad, apex rounded, base acute; stamens numerous, androphore 1.5 mm. long, filaments 1–1.5 mm. long, thecae linear, 6–7 mm. long, pollen grains monosulcate, large (*Jack 8103*), 61 μ long, 40 μ deep, 43 μ broad, exine rough, connective produced beyond the thecae in a setaceous tip 6–7 mm. long; gynoecium ovate, 1–1.3 cm. long, 8–9 mm. broad at anthesis, carpels 5–8, glabrous, style recurved, 2 mm. long; fruit ovoid, 2.5 cm. long, 2.5 cm. diameter at maturity; seeds solitary, rarely 2, oblong in outline, 12 mm. long, 7 mm. broad, 4 mm. thick, outer seed coat red-orange.

CUBA: Oriente: Sierra Maestra, Grosse Roche, *Linden 2040* (TYPE, not seen), La Gran Piedra, *Ekman 1662* (S) in flower in June, *8836* (S), in sterile condition in November; Pico Turquino, *León 11006* (NY), in flower July, 1200–1300 m. alt.; Loma Cardera, south of Turquino, *Roig & Bucher 6665* (NY), at 1300 m. alt. in bud in August; Turquino region, *Bucher 155* (NY) in bud in 1930; Pico Turquino, *Ekman 5540* (S) in sterile condition in April, at 1200 m. alt.; La Bayamesa, *Ekman 7161* (S), in sterile condition in May; Rio Yara to Rio Palmamocha, *Ekman 14406* (S), at 1100 m. alt., in flower in July; Rio Palmamocha to Loma Joaquin, *Ekman 5571* (S), at 1200 m. alt., in sterile condition in April; Sierra de Nipe, Loma Mensura, *Ekman 9914* (S), at 725 m. alt., in sterile condition in Oct. Las Villas: Lomas de Banao; Gloria Hill, *León & Roca 8014* (NY) at 950 m. alt., in fruit in July, El Purial, *Ekman 16232* (S), at 850 m. alt.,

in fruit in Jan., *Luna 512* (NY), in flower in May; Trinidad Mountains, Buenos Aires, *Jack 7434* (FM, US), at 8–1100 m. alt., in flower in July, *8103* (A, FM, NY, US) in flower in July, *8599* (NY, US) in sterile condition.

Local names: Marañon de costa de la Maestra, Marañon de la Maestra (fide Ekman).

Two sterile specimens from Puerto Rico can not be referred to the species now known from that island. These most closely approach *M. cubensis* although the stipules (13 cm. long) and the leaves (15–18 cm. long, 8 cm. broad) are much larger. The specimens are *Britton & Bruner 5563* (NY) collected in Feb. at 600 m. alt. on the Cataline-Yunque trail in the Luquillo Mts. and *Heller 740*, collected in March on the north slope of the Luquillo Mts. Additional material may show that these specimens represent a third, yet undescribed, species in Puerto Rico.

MAGNOLIA DOMINGENSIS Urb. Repert. Sp. Nov. **13**: 447. 1914; Urban Ark. Bot. **23A**[11]: 12, *fig. 1*. 1931. Fig. 34. Tree, 3–4 m. tall; branches densely villose; stipules 2.5 cm. long, densely villose; leaf blades obovate, 7–11 cm. long, 4–7 cm. broad, coriaceous, glabrous above, densely villose below becoming glabrate, apex rounded, rarely obtuse or slightly emarginate; base acute; petioles 1–1.5 cm. long, 2 mm. thick, densely villose; infrutescence terminal, not known in flowering condition; fruiting peduncles 7–9 mm. long, pedicel not evident, mature fruit oval to oblong, 3 cm. long, 1.5 cm. diameter, carpels about 14, persistently crispose or woolly-pubescent; seeds 2, oblong or triangular, 6–8 mm. long, 4–5 mm. broad, 2–4 mm. thick, outer seed coat dull red when dry.

HAITI: Near La Barrière Couchant, *Nash & Taylor 1081* (NY, designated as a new type), collected in fruit in July at 925 m. alt.; Dept. du Nord, Port Margot, Morne Maleure, *Ekman, 2810* (S), collected at 11–1500 m. alt. in sterile condition in December.

Urban added to the original description of this species in a note in *Arkiv för Botanik* (**23A**[8]: 24. 1928) when he cited and referred to it three additional collections by Ekman. One of these collections was sterile (*Ekman 2810*), one was in fruit (*Ekman 3442*), and from the third one Urban described the flowers (*Ekman 13884*). Later (Ark. Bot. **23A**[11]: 11. 1931) Urban recognized the flowering specimen as distinct and as a new species, and he proposed that the fruiting material might well be still another new species. However in the present treatment the three Ekman collections cited by Urban are treated as follows: the fruiting material is referred to *M. emarginata*, the sterile specimen to *M. domingensis*, and the flowering specimen to *M. pallescens*.

MAGNOLIA PALLESCENS Urb. & Ekm. Ark. Bot. **23A**[11]: 10, 12, *fig. 2*. 1931. Fig. 33. Medium-sized tree; branches densely short-golden-tomentose; stipules 1.5–1.9 cm. long, densely short-tomentose; leaf blades obovate-orbicular to suborbicular, 6.5–9 cm. long, 4.5–7.5 cm. broad, coriaceous, glabrous above, persistently short-golden-tomentose below, apex rounded or truncate, occasionally with a short obtuse or emarginate apiculum, 1–2 mm. long, base obtuse or rounded; petioles 8–12 mm. long, 2–2.2 mm. thick, densely tomentose; flowers terminal, peduncles 1.2–1.5 cm. long, pedicels 5–6 mm. long in fruit, spathaceous bracts unknown, outer perianth segments broadly ovate, 2.3 cm. long, 1.3 cm. broad, inner perianth seg-

ments broadly to narrowly obovate, 3.2–3.5 cm. long, 1.5–2 cm. broad, apex rounded to subtruncate; stamens numerous, androphore 1 mm. long, filaments 1–1.5 mm. long, thecae linear, 8 mm. long, connective produced beyond the thecae into a setaceous tip 3.5 mm. long; gynoecium ovate, 1.5 cm. long, 9 mm. thick at anthesis; carpels 25–30, glabrous, stigmas recurved, 2 mm. long; fruit globose to ovoid, 2 cm. long, 2 cm. diameter; seeds 2, triangular, 3–4 mm. long, 3–4 mm. broad, 2–3 mm. thick, outer seed coat dark red.

DOMINICAN REPUBLIC: La Vega prov. Cordillera Central between Constanza and Valle Nuevo at Los Montazos, *Ekman 13884* (S, TYPE, US, isotype) at 2100 m. alt., in flower in Oct.; Trujillo prov., Ciudad Trujillo, *Schiffino 155* (G, Y) in fruit in Aug.

Local name: Evano verde (fide Schiffino)

The herbarium sheet from the Riksmuseum in Stockholm labelled "Typus" consists of 3 specimens with young fruits attached. Urban however described the species from a flowering specimen as he gives a description of the perianth and the stamens. It is obvious that the true type specimen was at Berlin and is presumably destroyed and the specimen labelled "Typus" from Stockholm is a replacement type specimen.

The specimens collected by Schiffino bear an incomplete label written in ink. I seriously doubt if this plant was collected in Ciudad Trujillo, a few feet above sea level, as the label implies.

Magnolia Hamori Howard, sp. nov. Fig. 1. Arbor mediocris, 15 m. alta; ramis breviter flavido-sericeis; laminis ovalibus, 7–10 cm. longis, 5.5–7 cm. latis, tenuiter coriaceis, supra glabris, nervo medio subtus prominenti, e basi usque ad 5–7 mm. sericeo, ad apicem leviter bilobatis, lobis asymmetricis, ad basim rotundatis; petiolis 1.5–1.8 cm. longis, sericeis; floribus terminalibus, albis, fragrantibus, perianthii segmentis exterioribus oblongis, 4.5 cm. longis, 2 cm. latis, segmentis interioribus 6, obovatis, 4.5 cm. longis, 2 cm. latis, staminibus numerosis, filamentis 0.5–1 mm. longis, thecis linearibus, 9 mm. longis, connectivo in filum 7–12 mm. longum excurrenti; gynaeceo ovato, glabro, carpellis 18–21; ovulis 2; stigmate arcuato, 3 mm. longo; fructu oblongo, 3.5–4 cm. longo; seminibus 2 vel 1, extus roseis.

Tree to 15 m. tall; trunk 34 cm. diameter at breast height, bark dark gray, smooth; branches terete, sericeous-golden-pubescent; stipules 5.5–9 cm. long, terete, apex long-acuminate, sericeous-pubescent; leaf blades oval, 7–10 cm. long, 5.5–7 cm. broad, thin-coriaceous, glabrous above, glabrous beneath except for the basal portion of the midrib, apex asymmetrically bilobed, the lobes rounded, base rounded; petiole 1.5–1.8 cm. long, 1.5 mm. diameter, densely sericeous; flowers terminal, solitary, peduncle 11–16 mm. long, sericeous, spathaceous bracts 2, partly to completely fused, 3.5 cm. long, 3 cm. broad, strongly apiculate when closed around the flower, densely sericeous; perianth segments all petaloid, the outer three oblong, 4.5 cm. long, 2 cm. broad, emarginate at the apex, the lobes unequal, the inner perianth segments 6, rarely 7–9, obovate, 4.2–4 8 cm. long, 2.5–3.5 cm. broad, rounded at the apex; stamens numerous, androphore 3 mm. long, filaments 0.5–1 mm. long, thecae linear, 9 mm. long, pollen grains monosulcate, large (*Howard 8484*) 99 μ long, 57 μ deep, 61 μ broad, exine rough, connective produced into a setaceous tip 7–12 mm. long; gynoecium ovoid, 1.5 cm. long, 1.2 cm. diameter at anthesis; carpels 18–21, glabrous,

ovules 2 in each cell, arranged in a line one above the other, styles strongly recurved, 3–5 mm. long; fruit oblong, rarely ovoid, 3.5–4 cm. long, 2.5–3 cm. diameter, almost all carpels setting seeds; seeds 2, or 1, oblong or triangular, 8–10 mm. long, 5–7 mm. broad, 3–5 mm. thick, outer seed coat pink to red-orange.

DOMINICAN REPUBLIC: Barahona province: Monteada Nueva, East of Polo, *Howard 8484* (TYPE, G), at 1350 m. alt., in flower and fruit August 21, 1946, wet deciduous forest on limestone rock; *Hamor without number* (NY) in flower and fruit Aug. 3, 1947, same locality.

Local name: Caimoní. This name is also applied to *Wallenia laurifolia* (Jacq.) Sw. found growing at lower altitudes in Barahona province.

This species is named in honor of Mr. George Hamor, of the Barahona Sugar Company, Barahona, Dominican Republic. It was through his kindnesses that my wife and I were able to visit and collect at Monteada Nueva. At our request Mr. Hamor later located other trees and supplied mature wood and preserved flowers and fruits of this species.

Magnolia Hamori grows in small stands on the limestone hilltops in a wet cloud forest. Most of the other hilltops at this altitude are covered with open stands of *Pinus occidentalis*. The flowers are numerous on the tree; are a clear white color when fresh and have a very strong odor likened to the skin of fresh lemon or lime. The shape of the leaf and the distribution of the pubescence is of interest. The blade is oval and the apex emarginate and asymmetrically lobed. Over 300 leaves were examined and not one could be found with symmetrical lobes. One lobe was smaller than the other varying from 3 to 10 mm. shorter, thus presenting a very characteristic asymmetry. The thin coriaceous blades are glabrous on both surfaces and shining above when fresh. The branches, inflorescence axis and the petioles are golden-sericeous-pubescent. The pubescence extends from the petiole up the midrib on the lower surface for a distance of about 5–7 mm. In all of the material examined the pubescence had this distinctive distribution. *Magnolia Hamori* is most closely related to *M. emarginata* which has obovate leaves, often emarginate at the apex, but on which the lobes are always uniform and similar. The shoots and petioles of *M. emarginata* are always glabrous.

The following description of the mature wood of *M. Hamori* was supplied by Mr. James Canright. Pores numerous, 70–80 per sq. mm.; generally solitary, but with some tendency to form radial rows of 2–4; radial diameter up to 115 μ; walls thin, 2–2.5 μ thick; angular in transverse section. Vessel members 0.7–1.0 mm. long; fine spiral thickenings usually present; thin-walled tyloses few; scalariform perforation plates 10–25 barred; angle of end wall 30–40°; intervascular pitting scalariform to transitional; ray-vessel pitting unilaterally compound. Fibers comprise ground mass of the wood; slit-like pit apertures, oblique, exceeding pit border outlines (fiber tracheids); fairly thick-walled, i.e., on the average lumen equal to the wall thickness. Rays heterogeneous type IIA of Kribs; 5–25 cells high and 1–3 cells wide, with oil cells dispersed among the upright marginal cells. Wood parenchyma in terminal lines 1–3 cells wide.

A chromosome count of 38 was obtained from smears of lateral buds and the terminal shoot of seedling material germinated from seeds of *M. Hamori* from the type collection. This count places *M. Hamori* with the

diploid species of the genus *Magnolia* and is, unfortunately, the only count available on the native West Indian species.

MAGNOLIA EMARGINATA Urb. & Ekm. Ark. Bot. **23A**[11]: 11, 12, *fig. 3.* 1931. Tree, 10–15 m. tall; branches glabrous; stipules to 5 cm. long, glabrous; leaf blades obovate to obovate-orbicular, 7–10 cm. long, 5–8 cm. broad, glabrous, coriaceous, apex rounded to truncate, generally more or less emarginate, base acute to rounded; petioles 1–1.5 cm. long, 1.3–1.8 mm. thick, glabrous; flowers terminal, peduncles 7–10 mm. long, spathaceous bracts obtriangular, 4 cm. long, 3 cm. broad, deeply incised; pedicel 8 mm. long; outer perianth segments obovate-orbicular, 2.5–3 cm. long, 2–2.8 cm. broad, apex rounded, base narrowed or rounded; inner perianth segments narrowly obovate, 3.5 cm. long, 1.9–2.2 cm. broad, apex rounded, base narrowed; stamens numerous, androphore 2.5 mm. long, filaments 1 mm. long, thecae linear, 9–10 mm. long, pollen grains monosulcate, large (*Ekman 4339*), 73 μ long, 40 μ deep, 43 μ broad, exine not rough, connective produced beyond the thecae into a setaceous tip 5 mm. long; gynoecium obovate, 1.7 cm. long, 1 cm. diameter at anthesis, carpels 15–20, glabrous, styles recurved, 3 mm. long; fruit oblong, 3–3.5 cm. long, 2.5 cm. diameter, glabrous, fruiting carpels 1 cm. long, seeds not seen.

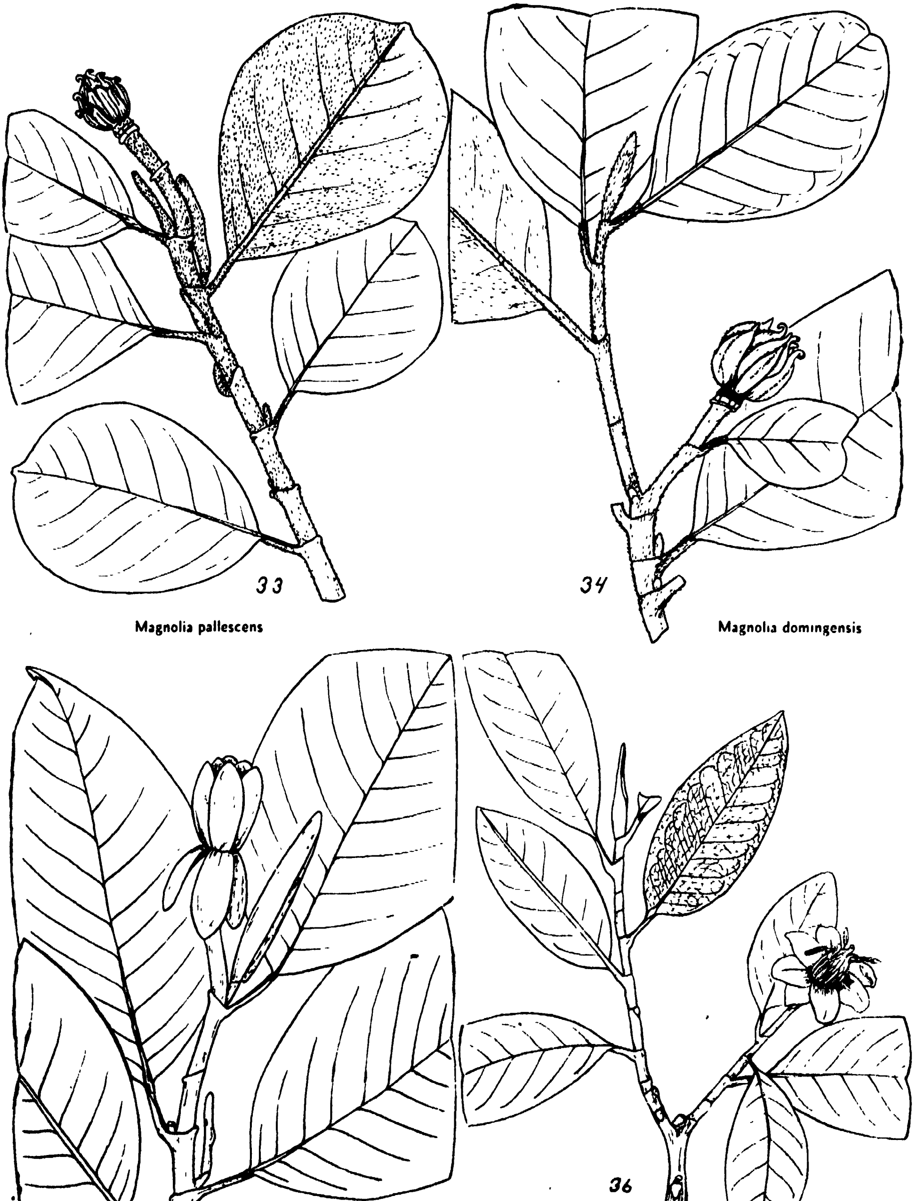
HAITI: Massif du Nord, near Anse-à-Foleur at the peak of Morne Colombot, *Ekman 4339* (S, TYPE, US, Isotype), at 900 m. alt., in flower in June; Massif des Cahos, Petit Rivière de l'Artibonite, Perodin, *Ekman 3442* (S), at 1300 m. alt., in fruit in March.

MAGNOLIA EKMANII Urb. Ark. Bot. **23A**[11]: 12, *fig. 4.* 1931. Fig. 35. Tree; branches glabrous; stipules 4.5–5.5 cm. long, glabrous; leaf blades oval, 9–13 cm. long, 6.5–8 cm. broad, glabrous, coriaceous, apex rounded or with an obtuse apiculum 2 mm. long, base slightly rounded or protracted into the petiole; petioles 2 cm. long, 1.8–2 mm. thick; flowers terminal, peduncle 1.5–2 cm. long, spathaceous bract ovate, 3.5 cm. long, pedicel 0.5 cm. long; outer perianth segments obovate, 3–3.5 cm. long, 1.6–2.2 cm. broad, rounded at the apex, narrowed below, strongly reflexed at maturity; inner perianth segments obovate-spatulate, 3.5–4 cm. long, 1.3–1.5 cm. broad, apex rounded or short and obtusely acuminate; stamens numerous, androphore 3–3.5 mm. long, filaments 1.5 mm. long, thecae linear, 1.3–1.4 cm. long, connective produced into a setaceous tip; gynoecium oblong, 1.5 cm. long, 8 mm. diameter at anthesis; carpels about 10, glabrous, styles recurved, 3 mm. long; fruit not known.

HAITI: Massif de la Hotte, near Jeremie in the mountains between Lapineau and Morne Pain-du-sucre, *Ekman 10395* (S, TYPE) at 1200 m. alt., in flower in July.

Ekman's field notes describe this collection as from a large tree growing at the edge of pinelands. Only two stamens are left on the specimen seen and the connective tip is broken on both of these. 2–3 mm. of the connective tip remains on the longer stamen.

TALAUMA Juss. Gen. 281. 1789. Trees; leaves evergreen, coriaceous, entire; stipules surrounding the branches, connate above, adnate to the petiole almost to the apex leaving a persistent petiolar scar; flowers terminal, solitary or a few developed into a terminal corymb, spathaceous bracts, surrounding the bud, connate, flaring and persistent for a short time after anthesis; outer perianth segments 3, ovate to broadly ovate,



Explanation of figures 33–36

Fig. 33. *Magnolia pallescens.* Habit, $\times \frac{1}{2}$. Fig. 34. *Magnolia domingensis.* Habit, $\times \frac{1}{2}$. Fig. 35. *Magnolia Ekmanii* Habit, $\times \frac{1}{2}$. Fig. 36. *Magnolia cubensis.* Habit, $\times \frac{1}{2}$. Note the free stamens held by the setaceous connective tip imbedded in the gynoecium.

coriaceous; inner perianth segments 6, the outer 3 elliptic, the inner 3 oblong; stamens in 2–several series, filaments short, thecae linear, introrse, approximate at the apex, connective slightly extended into an orbicular apex; gynoecium round to oblong, carpels 10 to numerous, fused, ovules 2 in each carpel, arranged one above the other; styles linear, free, ascending or slightly recurved, stigmatic on the inner surface, deciduous; fruiting carpels closely packed and connate, woody, dehiscent individually or in large irregular masses, seeds 2, hanging from the persistent woody base by long funiculi, short oval to obtusely triangular, outer seed coat red-brown, inner seed coat woody, endosperm oily, embryo minute, radicle suborbicular, cotyledons short.

Leaves acute or rounded at the base, often decurrent on the petiole.
  Carpels 8–12, dehiscing independently; petioles 1–3 cm. long; perianth segments 1–1.5 cm. long; anthers 3 mm. long. *T. minor.*
  Carpels 40 or more, dehiscing in large irregular masses; petioles 5–6 cm. long; perianth segments 11–12 cm. long; anthers 1.6 cm. long. *T. dodecapetala.*
Leaves truncate at the base, slightly if at all decurrent on the petiole. *T. truncata.*

TALAUMA MINOR Urb. Symb. Ant. **7**: 22. 1912; Repert. Sp. Nov. **20**: 302. 1925. Fig. 26.

Talauma Plumieri Griseb. Mem. Am. Acad. II. **8**: 154. 1860; not DC.; Griseb. Pl. Cub. 2. 1866.

Talauma (?) *orbiculata* Brit. & Wils. Bull. Torrey Club **50**: 37. 1923.

Svenhedinia minor Urb. Repert. Sp. Nov. **24**: 3. 1927.

Tree to 20 m. tall; branches glabrous, stipules 1.5–2 cm long, glabrous; leaf blades oblong, ovate, obovate, or orbicular, 8–14 cm. long, 4–9 cm. broad, coriaceous, glabrous and shining on both surfaces, venation conspicuously reticulate on both surfaces; petioles 1–3 cm. long, stipular scars present to near the base of the petiole; flowers terminal, solitary or several developed into a leafy corymb, fragrant; peduncle 2 mm. long, spathaceous bract ovate, 1.4–1.7 cm. long, 2–2.5 cm. broad, glabrous, pedicel 0.5–1 mm. long; outer perianth segments obovate-oblong, 1.5–1.8 cm. long, 1–1.3 cm. broad, inner perianth segments 6, 1–1.5 cm. long, 5–8 mm. broad; stamens in 2 series, 20–25, androphore 1 mm. long, filaments 0.2 mm. long, anthers oblong, thecae linear to oblong, pollen grains monosulcate, large (*Shafer 8335*) 59 μ long, 33 μ deep, 33 μ broad, exine not rough, surface even, connective obtuse or apiculate beyond the thecae, 0.1–0.2 mm. long; gynoecium obovate-oblong, 8 mm. long, 6 mm. diameter at anthesis, carpels 8–12, glabrous, styles erect or spreading, slightly recurved at the apex, 2 mm. long; fruit globose, 2 cm. diameter; seeds 1 or 2 in each locule, 8–10 mm. long, 3.5–4 mm. broad, 3–4 mm. thick.

CUBA: Oriente: Rio Yara, *Wright 1100* (G, TYPE, FM) in flower and fruit in July, Sierra de Nipe, road to mine at Woodfred, *Victorin & Clement 22087* (G); Rio Yamaniguey, *Shafer 4234* (NY, US), in fruit in Feb.; Moa Bay, east of Rio Moa, *Shafer 8335* (NY, US), in flower in January; Rio Seboruco to Falls of Rio Mayari, *Shafer 3691* (NY, US), in flower in January; Camp La Gloria, Sierra de Moa, *Shafer 8292* (NY), in flower in December–January; Cojimaya, Mayari, *Roig 160* (NY), in bud in September; Palmarito de Cauto, *Cuebelo 6223* (NY), in sterile condition in June; Turquino Region, *Bucher 189* (NY); Loma de Quintin-Nagua, *León 10955* (NY, Type of *T.* (?) *orbiculata*), in flower in July.

Local names: Laurel florida, Marañon de costa.

Urban established the genus *Svenhedinia* with the single species *S. minor* in Repert. Sp. Nov. **24**: 3 (1927). He notes the similarity to *Talauma* and distinguishes between them by the smaller number of stamens and carpels in *Svenhedinia* and the fact that the fruiting carpels dehisce individually in *Svenhedinia*. These characters seem to me to be more of specific than generic rank. Urban failed to recognize such similarities as stipules fused to the petiole leaving a persistent petiolar scar almost to the base of the lamina; a similar dehiscence of the carpels by circumscissile abscission leaving the seeds attached to the permanent woody base, and the very short extension of the connective beyond the thecae of the stamens. I have reduced the genus *Svenhedinia* to the synonymy under *Talauma* and recognize three species in the West Indies.

TALAUMA DODECAPETALA (Lam.) Urb. Repert. Sp. Nov. **15**: 306. 1918.

Annona dodecapetala Lam. Encycl. 2: 127. 1786.
Magnolia plumieri Sw. Fl. Ind. Occ. 2: 997. 1797.
Magnolia linguifolia Desc. Flor. Ant. 2: 140, *pl. 103*. 1822.
Talauma plumieri DC. Prodr. 1: 81. 1824.

Trees to 40 m. tall; branches sericeous becoming glabrate; stipules not seen; leaf blades lanceolate in juvenile leaves, 40–45 cm. long, 15 cm. broad, glabrous, shining on both surfaces; leaf blades on older plants oval to obovate-oblong, 18–20 cm. long, 10–14 cm. broad, glabrous, shining on both surfaces, apex and base acute to rounded; flowers terminal, peduncle 0.7–1.5 cm. long; spathaceous bracts 5–7 cm. long, 7 cm. broad, splitting irregularly and persistent, pedicel 2–5 mm. long; outer perianth segments 3, broadly oval 7–8 cm. long, 3 cm. broad, acute at the apex, inner perianth segments 6–9, broadly oval to oblong, 11–12 cm. long, 3 cm. broad; stamens numerous, androphore 4–6 mm. long, filaments 2 mm. long, anther oblong, thecae linear, 1.6 cm. long, pollen grains monosulcate, large (*Duss 3908*) 108 μ long, 56 μ deep, 61 μ broad, exine not rough, surface slightly uneven, connective produced into an acuminate apex 2–3 mm. long, thick and fleshy; gynoecium globose to obovoid, 2.5–3 cm. long, 2 cm. diameter at anthesis, carpels 40 or more, glabrous, styles spreading, 6–8 mm. long; fruit oblong to obovoid, 6–8 cm. diameter, woody, carpels dehiscing in large irregular masses, seeds 2, persistent on the woody base, ovoid, compressed, 1 cm. long; outer seed coat red. Fig. 17.

GUADELOUPE: *Duss 3908* (NY), in flower in July, *2995* (FM, NY, US) in flower in March–June; *Badier without number* (G), in flower in September; *Griffin without number* (FM). ST. VINCENTS: *H. H. Smith and G. W. Smith 1234* (NY), in sterile condition in March. DOMINICA: Trois Pitons, *Lloyd 775* (NY), in flower; Laudat, *Hodge 2121* (G) in sterile condition in March.

Local names: Magnolia, pin, bois pin, pomme pin in the British Islands and Cachiman montagne, bois cachiman in the French Islands.

Stehlé and Marie have reported in considerable detail on their field observations of this species (Le "Magnolia," *Talauma dodecapetala*, des petites Antilles, Carib. Forest. **8**: 183–201. 1947). *Talauma dodecapetala* is a large tree of hygrophytic forests found in mountain valleys at 450–800 m. altitude. A large tap root is developed. The trunk has a lightly fissured gray bark and large buttresses are developed. The crown is pyramidal when young becoming rounded with age. The trees flower about their

13th year but do not set fruit until several years later. The flowers are large, white and aromatic, and last about eight days. Few young trees are found since the seeds are eaten by birds for their fleshy, brightly colored outer seed coat. Few of the seeds that are produced are fertile and germination is difficult.

Young trees produce an extensive sapwood which is of little value. In the older trees the heartwood is valued for cabinet making and for boat stays. It is durable, hard and difficult to mill but when properly prepared it takes a beautiful finish and is resistant to insect attacks.

Talauma truncata (Moldenke) Howard, comb. nov.

Svenhedinia truncata Moldenke, Phytologia 2: 142. 1946.

Shrub or tree; branches glabrous; stipules connate and adnate to the petiole; leaf blades broadly ovate, 16 cm. long, 13 cm. broad, glabrous, shining on both surfaces, apex obtuse, base truncate; petioles 5.5–8 cm. long; inflorescence and fruit not known.

CUBA: Oriente: Alto Babiney, south of Turkuino, *Acuna 14069* (photograph at NY), in sterile condition in August. The type specimen, which I have not seen, is at the herbarium Estación Experimental Agronómica at Santiago de las Vegas, Cuba.

It has been shown in the early discussion in this paper that considerable variation exists in the leaves in species of *Talauma,* not only on one flowering shoot but also on sucker and vegetative shoots contrasted with flowering shoots. In general the leaves of sucker or vegetative shoots are larger than those of the flowering branches. I have considerable doubt that the material from which *T. truncata* was described is anything more than a vegetative shoot of *T. minor.* Some leaves of *Bucher 189* (NY) closely approach in size those of *T. truncata* and almost have the truncate leaf base regarded as the principal character distinguishing *T. truncata.*

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CULTURE OF PROLIFERATING ORCHID EMBRYOS IN VITRO[1]

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In the past ten years considerable advances have been made in the knowledge of plant tissue cultures. Tissues from the normal stem tip (White 1939), from sterile galls (White 1945), and from roots (Gautheret 1939) have been maintained *in vitro* and have been shown to be capable of unlimited growth. The capacity of the excised tissue to form organs has been demonstrated for tobacco (White 1939) and for carrot (Levine 1947). Similar calloid tissue has also been obtained from immature excised embryos (van Overbeek 1942), but its capacity for growth and differentiation has not been investigated.

Abnormal or unorganized types of orchid tissue occur only rarely, but they have been reported in seed cultures by a few investigators. Bernard (1909), Hammerschmidt (1915), and Burgeff (1936) described cases in which an abnormal proliferation of the embryo axis produced several to many growing points. Unorganized growth was not continued, as each growing point gave rise to an apparently normal plant. A more extreme case of embryo proliferation was reported by Curtis (1947) for seeds of *Vanda tricolor*. Many growing points were present but there was no evidence of leaves or stems after a growing period of two and one-half years; the resulting mass of tissue was superficially similar to the tobacco callus described by White (1939). A further description of the *Vanda* tissue, together with a discussion of a second type of tissue occurring as a result of proliferation of embryos of *Cymbidium* seeds, will be presented here.

The orchid seed is a dust-like particle which usually consists of a relatively undifferentiated embryo enclosed by a translucent membranous testa. At maturity, the embryo is comparable to the proembryo stage in the development of the more complex embryos of other kinds of angiosperms. The slight degree of morphological differentiation and the absence of nutritive tissues render the orchid seed favorable material for experiments dealing with the early nutrition and development of embryos. Undifferentiated masses of tissue were first observed during the course of such experiments. By frequent subculture of these tissues, an abundant supply of material for experimental work has been obtained.

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Materials and Methods. The embryo of the *Vanda tricolor* seed averages $77 \times 197\ \mu$ in size and is composed of approximately 120 cells. Except for an enlarged basal cell, no tissue differentiation of the embryo is observable. The embryo of the *Cymbidium* seed is slightly more differentiated, averages $146 \times 255\ \mu$, and is composed of about 450 cells. The remains of the suspensor may usually be distinguished at the base of the embryo. The degree of meristem differentiation varies from seed to seed, some having markedly smaller cells containing dense cytoplasm at the distal part of the embryo, others having essentially a uniform cell size throughout.

The initial cultures from which the proliferating embryo tissues of *Vanda* were obtained were prepared by the following standard procedure: the seeds were surface-sterilized with calcium hypochlorite, prepared by suspending five grams of the salt in 70 ml. of water, shaking thoroughly, and filtering. After the seeds were thoroughly wet with the hypochlorite, the solution was removed with a pipette and the seeds were washed into a small Erlenmeyer flask containing about 15 ml. of sterile water. Uniform portions of this seed suspension were transferred to bottles of culture medium by means of a rubber-bulb pipette. The density of the suspension was adjusted so that each bottle received about 300 good seeds. The culture medium had the following composition in millimols: NH_4NO_3—2.000; $(NH_4)_2SO_4$—0.984; KH_2PO_4—0.804; $MgSO_4 \cdot 7H_2O$—0.486; $MgNH_4PO_4 \cdot 6H_2O$—0.285; $FePO_4$—0.146; $CaCl_2 \cdot 2H_2O$—0.118; with 0.059 M. sucrose and 1.6% agar. Culture containers were four-ounce, square, druggist's bottles with metal screw caps. An airtight seal was maintained by a tinfoil or aluminumfoil lining in the cap. The cultures were placed in an incubator at a constant temperature of 28° C. ± 2° C. under a daylength of 18 hours provided by Cooper-Hewitt fluorescent lights at an intensity of 50 foot candles.

Proliferating embryos of a *Cymbidium* hybrid (*C. Falcon* × *C. Ophir*) were obtained from a large flask of seedlings kindly contributed by Dr. C. K. Schubert of Clarelen Orchids in Madison. Seed treatments were the same as those described above; the medium was also the same except that it was supplemented with 0.1% peptone. The seedlings had been maintained in a humid greenhouse at a temperature of 26° to 28° C.

Proliferating embryo tissues to be subcultured were removed from a stock bottle into a sterile petri dish with a sterile scalpel, cut into pieces a few millimeters on a side, and transferred to identical bottles of fresh medium. Fifteen replicates were set up for each variable in an experiment, each bottle containing two tissue fragments.

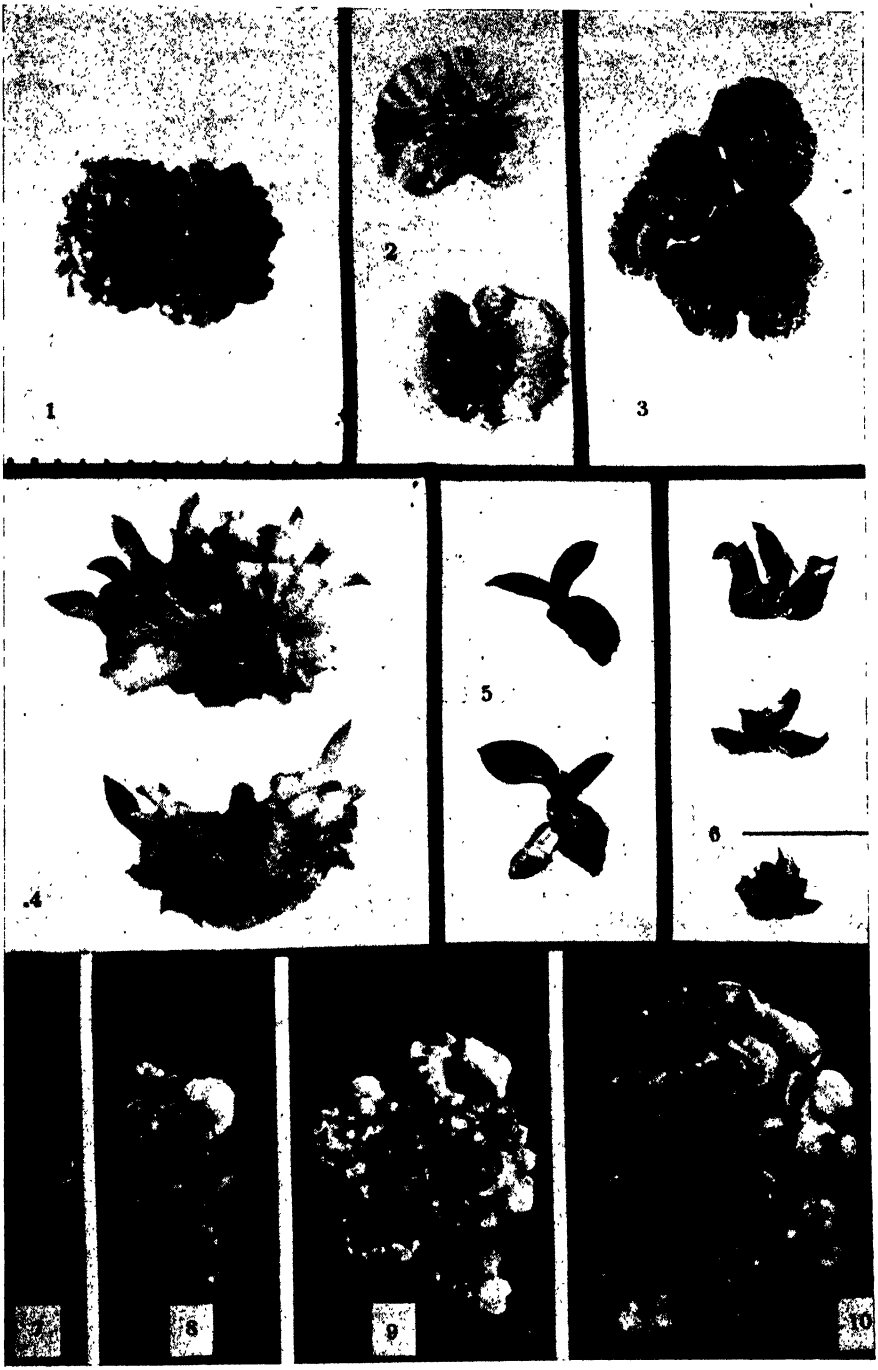
The preliminary investigations reported below on the histology of the tissue were carried out on paraffin sections, cut at 10 microns, and stained with either safranin and fast green, or with Delafield's haematoxylin.

Observations. The particular experiment in which large numbers of undifferentiated tissue masses of *Vanda tricolor* first appeared was one in which seeds had been grown on media each containing one of several derivatives of barbituric acid. The masses occurred on both basal and supplemented media, but were more numerous on the latter. The ratio of callus-like masses to seedlings on basal medium was approximately 1 to 100, whereas on the barbiturate-supplemented media the ratio increased to values as high as 1 in 20. Tissues from the *Cymbidium* hybrid arose on a medium free of barbiturates. Approximately 25 individual masses of undifferentiated tissue were observed in the original flask of nearly 1,000 seedlings. In recent months, similar proliferating embryos have been observed in seed cultures of *Cattleya, Maxillaria, Oncidium,* and *Paphiopedilum,* but they have not been studied sufficiently to be included in this report. From the original explants of both *Vanda* and *Cymbidium*, strikingly diverse patterns of organization have developed, as will be described below. All appeared in subcultures on both the basal medium and a medium enriched with 10 p.p.m. of sodium ethyl-(1-methyl-butyl) barbiturate.

VANDA TRICOLOR. When the masses of *Vanda* tissue were originally transferred, they varied from white, flattened thallus-like structures to yellow or green ovoid masses with undulate or pebbled surfaces. Only the green tissue has been studied further, as the white fragments proved to be too slow in development to be of experimental value. The difference in growth rate was apparently due to factors other than the mere presence or absence of chlorophyll as the green fragments grew well in the dark, although they lost their chlorophyll under such conditions. No macroscopically visible growing points could be observed at the time of transfer, but after a few months of culture, the individual growing points had become much enlarged and each formed a discrete segment-lobe as shown in figure 1. Frequently these segments became ridged on the dorsal surface. This relatively unorganized tissue mass is termed the generalized type, to differentiate it from tissues with a second type of organization or growth pattern which appeared later. This second type has been designated as a crest because of its resemblance to the crestate cacti (figs. 2, 3). The crests

Explanation of figures 1–10

FIGS. 1–10. Tissue masses and seedlings of *Vanda tricolor*. All × 3. FIG. 1. Generalized type of tissue. FIG. 2. Crested type of tissue. Upper and lower surface. Note dichotomy of dorsal ridges. FIG. 3. Clump of crests. FIG. 4. Upper and lower surface of crest with differentiated plantlets. FIG. 5. Two germinated protocorms, the lower with a root arising directly from the protocorm. FIG. 6. Several branched protocorms or embryo axes, each with a shoot. FIGS. 7–10. Series showing increase in size of the generalized tissue with time. FIG. 7. Original piece (0.011 gms. fresh wt.). FIG. 8. Piece from 15 week old culture (0.046 gms.). FIG. 9. 20 week culture (0.142 gms.). FIG. 10. 31 week culture (0.605 gms.).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are flattened masses of tissue made up of closely appressed, radiating lobes or segments. Each segment is characterized by a wing-like ridge on its dorsal surface and by rhizoid-like absorbing structures on its ventral surface. A considerable clump of these crests may be formed, as new crests often originate from the basal portions of existing crests (fig. 3). All transitional stages between the unorganized segments and the crests have been obtained. In some cases, the new growth produced from the base of a crest may revert from the crestate to the generalized form, but in no instance have the terminal meristems of a crest been observed to undergo such reversion.

Further differentiation of the tissue into leaves and stems and less frequently into roots has also been observed. This differentiation occurs at the distal tips of segments of both the generalized and of the crestate type (fig. 4). The small plants derived from the abnormal tissue cannot be distinguished from seedlings developing directly from the seed through normal germination.

It is especially interesting to compare the growth patterns of these proliferating embryo tissues with that of a normally developing embryo and seed. The normal embryo gives rise to a protocorm, which is a bulbous mass of tissue with tufts of absorbing hairs on its ventral surface and a wing-like structure on its dorsal side. After the protocorm has attained a length of 2 to 3 mm., a leafy shoot is formed at its distal tip as shown in figure 5. The structures observed in each segment of the undifferentiated tissue described above have their counterpart in this normal development. The relationship between the abnormal development and the normal type is further brought out by the structures shown in figure 6, in which the branched axis of the embryo represents an intermediate stage between the normal and the undifferentiated tissues described above.

INTERNAL ANATOMY OF VANDA. The internal anatomy of the generalized tissue in *Vanda* was studied in material obtained from the original culture at the time of initial transplantation as well as in material from later subcultures. As seen in a median section, an individual lobe of a large tissue mass consists of a fairly uniform group of parenchyma cells, with a thin meristematic region on the outer surface (fig. 23). There is no evidence of any differentiation of vascular strands or of other specialized tissues. The cells near the base of the lobe are isodiametric, while those nearer the surface are slightly elongated in a radial direction. The nuclei of the basal cells are large (17.0 to 22.0 microns in diameter), but they occupy only about 2.0 per cent of the cross-sectional area of the cells. Chloroplasts are more numerous in cells toward the outer surfaces. The superficial meristematic regions are from two to three cell layers deep, and from 50 to 250 cells in lateral dimensions. The cells in the outermost layer of these meri-

stems divide mostly in a radial direction although some divisions are tangential. Apparently the most active divisions take place in the layer immediately below the surface with a marked reduction in activity in the third layer, particularly toward the edges of the meristem. Nuclei in these dividing cells average only 4.7 microns in diameter, but they occupy about 25.0 per cent of the cell area.

Because of the greater activity in the central portion of the meristematic zone, a lenticular mound of cells is produced which later becomes hemispherical. Eventually the cells in the most active zone cease to divide and the centers of activity shift to the edges of the zone, where two or occasionally three new regions begin to divide actively. This gives rise to two or more new mounds or lobes on the sides of the old. The planes in which these new lobes appear are not oriented in a particular fashion, but occur in random directions, with the result that the entire tissue mass assumes a hemispherical form. The undulate or tuberculate external surface of the generalized type is thus composed of individual lobes each with its own superficial meristem.

The crestate type in *Vanda* differs from the generalized type primarily in that a certain orientation of the lobes is present. In early stages, this orientation results in a mass with two distinct surfaces which differ in the degree of their cell differentiation. The lower surface, which is usually in contact with the agar, develops groups of unicellular rhizoid-like hairs from convex, multicellular protuberances. The upper surface of the oriented crest develops carinate projections which are similar to that found on the normal protocorm. The meristems, like those in the generalized type, are superficial and confined to the outer three cell layers. Each meristem continues development for a longer period of time than is the case in the generalized type; when two new lateral meristems are produced they always form in the same plane, with a resulting dichotomy. This is well shown in figure 2. No vascular strands or other differentiated internal tissues can be found in the young crests, the isodiametric parenchymatous cells closely resembling those of the generalized type.

The increased number of separate meristems produced by repeated bifurcations in an old crest results in a curling or twisting of the entire mass (fig. 3). The crowding of the meristems into a nearly continuous line along the circumference of the mass greatly increases the resemblance to crested euphorbias or cacti so common in collections of succulent plants.

Certain profound differences appear in the internal anatomy .of the crests which produce organized growing points but the exact sequênce of these changes was not determined in this preliminary study. Examination of material which possessed well-developed external leaf primordia showed two major departures from the ordinary crests. The meristems of such

plants were greatly reduced in area and at the same time were increased in depth, so that they resembled the usual stem-tip primordia of other plants. Dividing cells were confined to a small hump, approximately eight cells in thickness at the median point. Vascular strands extended from the meristems to the place of origin of the individual lobes of the crest. In the most advanced stages examined, these strands contained continuous rows of scalariform xylem surrounded by three or four layers of small parenchyma cells.

The relative size of the vascular strands, their longitudinal extent, and their placement with respect to the stem primordium are the same in the differentiating crests as in the protocorm of the normal seedling. In fact, the individual lobes of such a crest are anatomically indistinguishable from the terminal portion of a protocorm and apparently they should be considered as homologous structures.

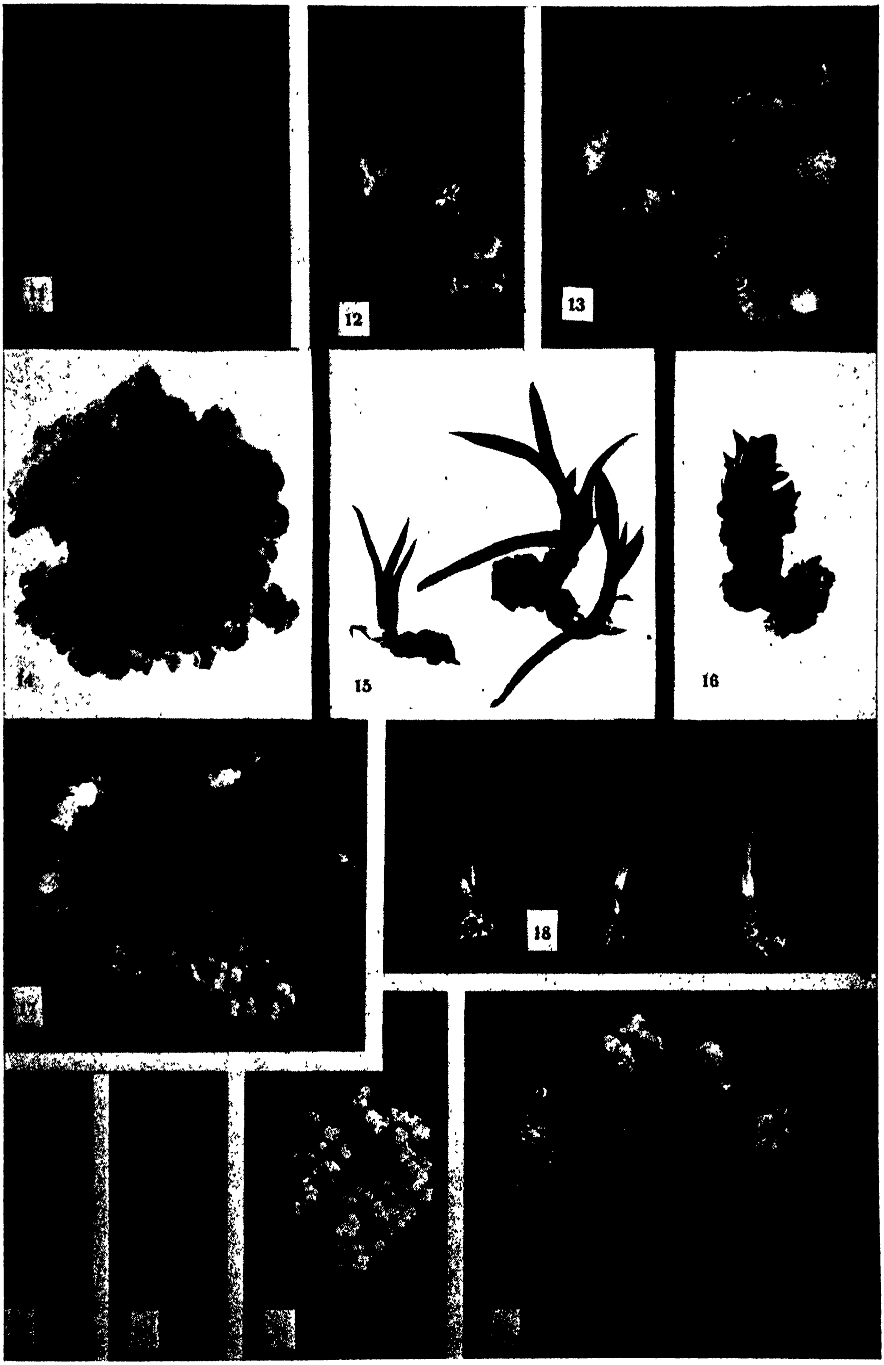
CYMBIDIUM HYBRID. The *Cymbidium* tissue when first transferred was a rather loosely knit mass of nearly translucent cells. As in *Vanda*, the surface was pebbled but individual growing points were just discernible macroscopically. The *Cymbidium* tissue originally varied in color from pale green to white, but all of the white tissue became green shortly after transferring.

The *Cymbidium* tissue has undergone considerable morphological change since the first transplantation. The most generalized form of growth is that shown in figure 11. This type differs from the original tissue only in the increased size of the growing points, which appear as more or less spherical masses, and in the presence of a few clusters of epidermal hairs scattered over the surface of the mass. New growing points arise from basal surfaces. Differentiation of morphologically normal shoots directly from the growing points occurs very rarely (fig. 12).

The first external indication of further organizational change in this type of tissue is the development in certain subcultures of an increased opacity of the individual growing points. After this change in opacity the growing points become much larger than those of the generalized type. This condition is shown in figure 13, in which the number of growing

Explanation of figures 11–22

FIGS. 11–18. Tissue masses and seedlings of *Cymbidium* hybrid. All × 1.7. FIG. 11. Generalized type of tissue. FIG. 12. Shoot differentiated directly from generalized type. FIG. 13. Corm type of tissue, with large lobes. FIG. 14. Pubescent type of tissue. FIG. 15. Elongate type of tissue, with differentiated plantlets. FIG. 16. Strobilus type of shoot differentiated from elongate tissue. FIG. 17. Dactyloid type of tissue. FIG. 18. Normal protocorms, with shoots. FIGS. 19–22. Series showing increase in size of generalized *Cymbidium* tissue with time. All × 0.7. FIG. 19. Original piece (0.012 gms. fresh wt.). FIG. 20. Piece from 13 week old culture (0.201 gms.). FIG. 21. 24 week culture (1.682 gms.). FIG. 22. 61 week culture (9.123 gms.).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points per gram of fresh tissue is approximately 60. In comparison with this, the average number of growing points in the generalized type is 330 per gram. When the growing points have become enlarged they continue to proliferate in the same pattern. This modification is termed the corm type, because of the resemblance of each growing point or lobe to the protocorm of a normal seedling.

FIG. 23. Section through a lobe of generalized tissue of *Vanda tricolor*, showing superficial meristem. × 203.

A second distinct type of organization occurs in other cultures after the development of increased opacity but before the growing points become as swollen as in the corm type. After a slight enlargement of each growing point, the tissue becomes a much deeper green, and the number of clusters of rhizoid-like hairs increases greatly, resulting in a mass of pubescent tissue as shown in figure 14. The hairs become larger and the epidermal areas from which they arise increase in extent. This type of growth, once established, is maintained, and at present is continuing through the third transfer. Occasionally, however, one of the growing points may give rise to a shoot which, at least in external appearance, is identical with that of a normal *Cymbidium* seedling.

A third deviation from the generalized type of tissue occasionally arises from the corm type. In this type of growth the enlarged lobes do not continue to proliferate but instead become much elongated. Shoots may form at the tips of the growing points, as shown in figure 15, and some of these

shoots may develop roots, becoming to all external appearances identical in form with normal *Cymbidium* seedlings. In some cases, the elongated lobes may follow the pattern indicated in figure 16, in which the shoot becomes encased in short, succulent leaves, giving the appearance of a strobilus. In only one case was a root observed on one of these abortive shoots.

The different patterns of growth thus far described bear a fairly clear relationship to one another, and intermediate stages between them can be easily found. The transition is more obscure in the fourth type (fig. 17), which sometimes develops as a modification of the generalized form. Arising from the mass of tissues are many small dactyloid projections which are usually bifurcate but may be as many as 9-partite. The projections, which completely cover the mass of tissue, are glistening white and resemble the more translucent tissue of the parent type.

As was the case with the abnormal tissue from the *Vanda* seeds, the *Cymbidium* tissue may be interpreted in terms of normal seedling characteristics. In the usual development of a *Cymbidium* protocorm, a globular mass of green tissue is first formed. Scattered on its surface are local clusters of epidermal hairs. The protocorm then becomes more opaque, develops scale leaves and eventually differentiates a leafy shoot from its tip (fig. 18). In the generalized *Cymbidium* tissue and in most of the modifications, each of the growing points seems to be comparable to a single protocorm. Occasionally a protocorm may branch before differentiation of the shoot. This type of growth might be regarded as transitional between the simple protocorm as exemplified by *Vanda* (and most other orchids) and the extreme degree of proliferation of the tissues described above. The interpretation of the bifurcated projections of the dactyloid type, in terms of normal development, is not yet clear. They seem to bear a certain resemblance to the crests of *Vanda,* in that the finger-like outgrowths are commonly arranged radially in a single plane.

A study of the internal anatomy of *Cymbidium* tissues has shown the same general pattern to exist as that previously found for *Vanda.* The meristems of the generalized type in *Cymbidium* are superficial, in some cases being confined to the outer two cell layers. No vascular strands have been found in the actively growing lobes, but there is a more definite alignment of the internal parenchyma cells in a direction parallel to the longitudinal axis of the lobe. In those masses which have produced leafy shoots, well-developed vascular strands are present. The internal structure of these stem tips with their subtending lobes of tissue appears to be identical with that of the protocorm of a normal seedling.

INFLUENCE OF CULTURAL CONDITIONS ON GROWTH. The growth rate of *Vanda* tissue expressed as $\log_{10}$ of the fresh weight/time is constant during the first five months of culture, after which it slowly decreases. The per-

centage increase per week during the log phase, calculated according to Blackman's formula ($w_1 = w_0e^{rt}$), is approximately 15 per cent. Figures 7 to 10 illustrate the amount of growth obtained from a single fragment of tissue with increasing length of culture period.

The growth rate of *Cymbidium* tissue is considerably greater than that of *Vanda*. In a normal three-month culture period the fresh weight increases 20-fold. As in *Vanda*, the growth rate remains constant during the first five months of culture with a decline thereafter. The weekly percentage increase during the first five months is between 24 and 30 per cent. The growth rate of the tissues shown in figures 19 to 22 averaged 13.0 per cent per week over the entire 61 week culture period. In both *Vanda* and *Cymbidium* these growth rates are maintained in cultures grown in the dark as well as in those grown in the light.

All of the types of tissue described in the preceding sections were obtained both in the presence and in the absence of barbiturates and without any known change in the external cultural conditions. It must therefore be assumed that these patterns of organization were inherent in the original fragments of tissue from which they were derived, and were not induced by cultural conditions.

Some attempts have been made to regulate the growth pattern of the tissue through the regulation of the external environment. The effect of liquid culture on the growth of orchid seeds was demonstrated by Knudson (1946). He described spherical masses of tissue with many stem primordia which developed from submerged seeds. White (1939) reported organ differentiation from tobacco callus tissue when it was grown in submerged culture solution. However, submerged culture was eventually toxic to the tobacco tissues. In both *Cymbidium* and *Vanda* tissue it was found that submergence under two cm. of culture solution caused an immediate decrease in growth rate, with death of the tissue following shortly.

The possible influence of complex growth factors on *Vanda* tissue was studied by means of experiments in which yeast extract, pancreas extract, peptone, corn steep, and an ethyl alcohol extract of coconut meat were added to the basal medium at the rates of 100 p.p.m. and 1000 p.p.m. No consistent differences in the growth patterns were obtained by the use of these substances, nor were the amounts of growth, as measured by fresh weight, significantly different. In another experiment in which sucrose concentrations were varied from 0% to 8%, optimum growth took place on 1% sucrose, with somewhat poorer growth on the higher concentrations and with very little growth on the medium devoid of a sucrose supply. A preliminary investigation on the effect of indole-3-acetic acid was also made, using the acid at concentrations of 10^{-4}, 10^{-5}, and 10^{-6} molar. The growth rate of the *Vanda* tissue on the supplemented media was not sig-

nificantly different from that on the controls. The *Cymbidium* tissue, on the other hand, responded rather strikingly to a concentration of 10^{-5} molar indole-3-acetic acid. The immediate effect was one of toxicity, the tissue becoming blackened and apparently dead within a few days after transfer. However, within a month after it had been transferred to the supplemented medium, tiny pin-points of white tissue were observed. These minute centers of growth continued to proliferate rapidly, so that when the experiment was concluded at the end of three months, the final amount of growth was not markedly different from that of the controls. This may indicate some stimulating effect on the part of the auxin, but the results are difficult to interpret both because of the initial inhibition and because of the possible effect of break-down products which may have been released from the dead portion of the tissue. It is also interesting to note that the regenerated tissue was white, although the original fragment had been green. Except for color, all tissue produced on the auxin-supplemented medium was of the generalized type described above. No differentiation of leaves, stems, or roots was obtained, although the control tissue on basal medium alone, which had been derived from the same original tissue mass, gave rise to a number of plantlets. This effect is in line with the results reported for the influence of auxin on tobacco callus in liquid culture (Skoog 1944).

So far, no nutritional treatment or environmental condition has been discovered which will increase the amount of shoot production by any of the embryo tissue types of either species over that produced on the basal medium under standard conditions.

Discussion. The orchid tissues when first observed were comparable in external appearance to the tissue cultured by White (1939) from the stem of tobacco. They also resembled the carrot root tissue described by Gautheret (1939). However, their potentialities for organization have proved to be much greater than those of tissues from other sources. Tobacco tissue has been observed to form shoots only by a change in cultural conditions, such as by submersion in liquid culture medium. The calloid tissue from carrots regularly forms roots under ordinary culture conditions, but its differentiation into plantlets under these conditions has been reported only once (Levine 1947). In contrast to this, the orchid tissue has developed several discrete types of abnormal organization in addition to giving rise to apparently normal plantlets without evident change either in nutrition or in environment.

The internal appearance of the orchid tissue also differs markedly from that described for other types of calloid tissue. Tobacco tissue was described by White as being an undifferentiated mass of parenchyma cells with

scattered internal patches of meristematic cells and a few nonfunctional xylem elements. The orchid tissue has superficial meristems which produce only uniform parenchyma cells. Caplin (1947) reported that certain strains of the tobacco callus have developed a growth pattern which more nearly resembles that of the orchids. In these strains, surface or subsurface meristems occur; they may increase in number by a forking or fission similar to the bifurcation process described for the orchids.

As has been pointed out above, the orchid embryo is characterized by a lack of differentiation at seed maturity and by the production of a protocorm before the production of shoot or roots. The protocorm is the end result of a special, external type of embryo ripening which replaces the maturation stages normally occurring in other plants while the seed is still within the fruit. As such, the protocorm may be regarded as the mature embryo stage of the orchid. True germination, according to this concept, occurs only upon the emergence of the shoot from the protocorm. This idea of delayed germination has been referred to previously by Prillieux and Riviere (1856) and by later workers on orchid seed germination (Bernard 1909; Curtis 1936).

Ordinarily, after a protocorm has developed from a seed, no further development of the axis takes place, but rather a shoot primordium is differentiated. Under certain cultural conditions more than one shoot primordium may arise from a single corm (Hammerschmidt 1915), but these always develop into normal plants and the protocorm mass remains quite small. The tissues studied in this work were derived from embryos which had reached a stage comparable to a protocorm and then had continued proliferation in the same pattern, suggesting that the formation of organ primordia (i.e. true germination) was in some way inhibited in such tissues. This inhibition may be overcome in some cultures with the resultant production of normal shoots and roots.

The variability in growth rate of the orchid tissue is like that of similar cultures of tobacco, carrot, and other plants. The growth rate is not correlated with the parent tissue piece but is rather inherent in the particular fragment of tissue explanted. Sources of variability are the unavoidable differences in size, and the different proportions of meristematic tissue and maturing tissue in each explant. Similar variation is encountered in the study of differentiation, as its expression is probably influenced by the amount of internal development which has already occurred in the fragment explanted. For these reasons, large numbers of replicates were essential for significant results.

The exact factors responsible for the initiation of the proliferating embryos are not clearly understood at present. The degree of morphological

development of the individual seeds at the time of initial planting may be a factor of considerable importance. Results of many embryological investigations on orchids have shown that lack of uniformity in development of the seeds within a single fruit, both as to origin of the embryo sac and as to the final stage of embryo development, is the rule in most species. Swamy has recently shown that cleavage polyembryony is commonly present in *Cymbidium bicolor* (1942) and *Eulophea epidendraea* (1943) as a result of proliferation of sexually produced embryos while they are still within the ripening ovules. It is possible that a similar phenomenon may occur outside of the fruit in embryos which have not reached full maturity, and that a continuation of the cleavage process would give the proliferating tissues described above. Preliminary results with mass cultures of *Cattleya* embryos of varying degrees of immaturity have indicated that the percentage of proliferating embryo axes obtained on barbiturate-enriched media was definitely higher when unripe seeds were used. Additional evidence that the state of morphological development is important may be derived from observations on the immature embryos of other plants. For example, Brink, Cooper and Ausherman (1944) obtained calloid masses from certain hybrid embryos of a cross between *Hordeum jubatum* and *Secale cereale*, when these embryos were excised at an immature stage and maintained in artificial culture. Similarly, McLean '(1946) reported an instance of extreme embryo proliferation from an excised immature embryo of a hybrid between *Datura ceratocaula* and *D. metel*. This embryo, which was less than one-third of a millimeter in diameter at the time of excision, produced 106 buds during several months in culture. Many of the buds developed shoots and roots and were grown to maturity.

It is reasonable to suppose that embryos may differ in their state of physiological development as well as in their morphology and that these differences may stem largely from unequal accumulations of physiologically important substances. If this is the case, then the nature and concentration of substances supplied to the embryos when cultured in vitro may be of importance in determining the type of subsequent growth. Van Overbeek (1942) reported that immature excised embryos of *Datura* produced normal seedlings in the presence of unautoclaved coconut milk. On a basal medium or on autoclaved coconut milk, however, only calloid growth was obtained. It was suggested that the latter result was due to the release of auxin during the autoclaving process. In the orchid, the presence of barbiturates favors proliferation of the embryo axis from unripe seeds. Barbituric acid and its derivatives are the only agents which so far have been found to favor this pattern of growth.

It is hoped that further investigations will define more closely the con

ditions which lead to the production of proliferating embryo axes and to the differentiation of normal plantlets from such proliferated tissue fragments. Apart from the theoretical value of such information to the knowledge of growth and differentiation in general, the practical ability to produce clonal lines of plants in potentially unlimited numbers would be of obvious value in many types of genetic and plant-production work.

SUMMARY

1. Proliferating embryo axes of *Vanda tricolor* and a *Cymbidium* horticultural hybrid were maintained in artificial culture. The callus-like tissue masses were capable of potentially unlimited growth upon subculture, although they did not remain constant in form.

2. Tissues of *Vanda* consisted originally of groups of internally undifferentiated lobes, each with its own superficial meristem. In certain cases, a more definitely organized mass developed from this generalized type. It was characterized by the presence of a linear peripheral row of meristems and a differentiation of dorsal and ventral surfaces.

3. The embryo axes of *Cymbidium* had greater potentialities for change, as the original generalized type gave rise to five distinct patterns of growth, differing in such characters as size of the individual lobes and degree of rhizoid development.

4. The proliferating structures were similar in both external appearance and internal anatomy to the protocorms normally produced by germinating seeds of the orchids. In addition, they had the capacity for continued growth, but true germination, in the sense of shoot and root production, usually was inhibited. In some cases, with no known change in cultural conditions, the inhibition was overcome, and apparently normal plants with stems, leaves, and roots were produced.

5. The growth rate of *Vanda* tissue was approximately 15 per cent per week, while that of *Cymbidium* was between 24 and 30 per cent. Preliminary experiments showed that submergence in liquid cultures caused death of the tissues. No direct control of growth pattern could be shown by the use of a variety of complex growth factors or by a wide range of sucrose concentrations. Inhibition of shoot formation in *Cymbidium* could be maintained by indole-3-acetic acid at 10^{-5} molar concentration, but no treatment was discovered which would increase the amount of shoot production over that on the control solution.

6. Two factors believed to influence the occurrence of proliferating embryo axes were (1), the morphological state of development of the embryos at the time of planting and (2), physiological development in the sense of accumulation of materials. There were indications that immature

embryos were more likely to undergo proliferation than mature embryos. Barbituric acid derivatives were the only agents found which would increase the percentage of individuals which exhibited abnormal growth types.

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Literature Cited

Bernard, N. L'évolution dans la symbiose. Les Orchidées et leur champignons commensaux. Ann. Sci. Nat. Bot. IX. **9**: 1–96. 1909.

Brink, R. A., Cooper, D. C. & Ausherman, L. E. A hybrid between *Hordeum jubatum* and *Secale cereale*. Jour. Hered. **35**: 67–75. 1944.

Burgeff, H. Samenkeimung der Orchideen. Jena. 1936.

Caplin, S. M. Growth and morphology of tobacco tissue cultures *in vitro*. Bot. Gaz. **108**: 379–393. 1947.

Curtis, J. T. The germination of some native orchid seeds. Am. Orchid Soc. Bull. **5**: 42–47. 1936.

——————. Undifferentiated growth of orchid embryos on media containing barbiturates. Science **105**: 128. 1947.

Gautheret, R. Sur la possibilité de réaliser la cultur indéfinie des tissus de tubercules de carotte. Compt. Rend. Acad. Sci. Paris **208**: 118–121. 1939.

Hammerschmidt, R. Ueber einige interessant Erscheinungen an Orchideen-samlingen. Orchis **9**: 68–69. 1915.

Knudson, L. Experiment to show the growing points on orchid seeds germinated in liquid media. Am. Orchid Soc. Bull. **15**: 238. 1946.

Levine, M. Differentiation of carrot root tissue grown *in vitro*. Bull. Torrey Club **74**: 321–328. 1947.

McLean, Susanne W. Interspecific crosses involving *Datura ceratocaula* obtained by embryo dissection. Am. Jour. Bot. **33**: 630–638. 1946.

Prillieux, E. & Riviere, A. Observations sur la germination et le développement d'une orchidée (*Angraecum maculatum*). Ann. Sci. Nat. Bot. IV. **5**: 119–136. 1856.

Skoog, F. Growth and organ formation in tobacco tissue cultures. Am. Jour. Bot. **31**: 19–24. 1944.

Swamy, B. L. G. Female gametophyte and embryogeny in *Cymbidium bicolor Lindl.* Proc. Indian Acad. Sci. **15**: 194–201. 1942.

——————. Gametogenesis and embryogeny of *Eulophea epidendraca* Fischer. Proc. Nat. Inst. Sci. India **9**: 59–65. 1943.

Van Overbeek, J. Hormonal control of embryo and seedling. Cold Spring Harbor Symp. Quant. Biol. **10**: 126–134. 1942.

White, P. R. Potentially unlimited growth of excised plant callus in an artificial nutrient. Am. Jour. Bot. **26**: 59–64. 1939.

——————. Controlled differentiation in a plant tissue culture. Bull. Torrey Club **66**: 509–513. 1939.

——————. Metastatic (graft) tumors of bacteria-free *Vinca rosea*. Am. Jour Bot. **32**: 237–241. 1945.

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—IV

BASSETT MAGUIRE AND COLLABORATORS

ROSACEAE (*continued*)

Licania parvifructa Fanshawe & Maguire, sp. nov. Arbor magna; ramulis tenuibus, glabris, lenticellis albis, conspicuis; foliis lanceolatis, basibus subconduplicatis, supra glabris, reticulatis, subtus exigue pruinoso-tomentulosis; inflorescentibus anguste paniculatis; floribus non visis; fructibus orbiculato-ovatis, nodulosis lobatisque, stipitatis, indumentis compactis, rubro-fuscis, seminibus dense fusco-velutinis.

Tree at least 30 m. high and 50 cm. diam., branchlets slender, terete, glabrous, the exfoliating cuticle whitish, the bark reddish-brown, the lenticels raised, rounded, white, conspicuous; leaf blades 7–10 cm. long, (2) 2.5–3.5 cm. broad, subconduplicate at the base, acuminate-attenuate at the apex, with 6–7 pairs of primary veins, the upper surface glabrous, prominiously reticulate, the veins inconspicuous, on the lower surface most scantily pruinose-tomentulose, the primary veins prominent, the veinlets obviously reticulate, petioles ca. 5 mm. long, glabrous or sparsely strigulose, deeply transversely rugose, stipules more or less decurrent at the base, 2–3 mm. long, lance-subulate, somewhat carinate, glabrous, or sparsely strigulose; inflorescences axillary, 6–10 cm. long, narrowly paniculate, solitary or several in a leaf axil, essentially glabrous, bracts 1–2 mm. long, acute, strigulose, branchlets slender, cymules 1–3 flowered, the pedicels ca. 1.5 mm. long; flowering material not seen, but calyx evidently shallowly urceolate, broader than long, externally with a ring-like prominence near the base, minutely pubescent without, more closely hirsutulous within, stamens apparently 4–5; fruit 9–11 mm. long, stipitate, the body orbicular ovate, broader than long, some-flattened, prominently nodulose, sometimes lobed, the indument compact, granular, reddish-brown, thinly arachnoid within, ovules two, one maturing, seed irregular globose, pentagonally shallowly sulcate, closely brown-velutinous with admixed fine and coarser hairs.

TYPE: tree 100 ft. high, to 20 in. diam., leaves chartaceous, glaucescent below, simple panicles axillary and terminal, fruit obovate, crimson, seed coat thinly fleshy, seed a stone, from mixed Kautaballi forest on brown sand, Moraballi Creek, Essequibo River, British Guiana, *Fanshawe 588* (F.D. 3324). New York Botanical Garden. Cotype: along the Berbice-Rupununi cattle trail, Berbice or Demerara County, British Guiana, *A. A. Abraham 258*. Known only from British Guiana.

The following collection is with some uncertainty referred here: Tree 111 ft. tall (measured), 12 in. diam., unbuttressed, with very hard wood, leaves glaucous below, chartaceous, flowers in axillary and terminal short [(3) 5–12 cm. long] axillary and terminal inflorescences, buds greenish-yellow, perianth lobes patent, palest crimson, stamens 4, or 3 plus 1 aborted, horizontal, Siba Creek, Moraballi Creek, Essequibo River, British Guiana,

F661 (F.D. 3397). The leaves of this specimen are narrower, and the undersurface more evidently tomentulose than the type and cotype, the inflorescence puberulent, and the pedicels less than 1 mm. long. The flowers are ca. 1.5 mm. long and equally broad, the stamens 3–4. We strongly feel that this collection is conspecific with *Fanshawe 588* and *Abraham 258*.

Licania parvifructa is closely related to the Amazonian *L. microcarpa* Hook. f. and may ultimately be demonstrated to be a part of that species; however, in the isotype of the latter, the only authentic specimen seen, the leaf petioles are velutinous, the branchlets hardly at all lenticellate, and the quadrangular fruit 7–9 mm. long, olive-gray in color and not nodular and lobed. Certainly *L. microcarpa* Hook. f., *L. Duckei* Maguire, and *L. parvifructa* form a very closely interrelated complex.

Licania Persaudii Fanshawe & Maguire, sp. nov. Arbor mediocris; foliis amplis, ellipticis vel elliptico-oblanceolatis, abrupte acuminatis, basibus obtusis vel subacutis, supra glabris, venis prominentibus, subtus venis valde prominentibus, reticulatis, tomentulosis, inflorescentibus amplis, arachnoideo-tomentosis, cymulis brevi-pedunculatis; floribus sessilibus; calycibus companulatis, externe brevi-pilosis, apetalis; staminibus exsertis; fructibus globosis, glabris.

Tree to at least 18 m. high, 20 cm. diam., branchlets terete, glabrous; leaf blades (10) 12–20 cm. long, (3.5) 5–8 cm. broad, elliptic or elliptic-oblanceolate, rounded or merely acutish at the base, abruptly acuminate at the apex, 8–10 pairs of primary veins ascending at a 45° angle, somewhat arcuate, the midrib and lateral veins prominent on the glabrous upper surface, strongly so on the lower surface, the secondary veins transversely reticulate between the primary, the tertiary and veinlets prominently reticulate, midrib and veins glabrate, thinly and rather compactly light brown tomentose, petioles 8–10 mm. long, glabrate, transversely rugose, sessile, biglandular at or near the base of the blades, the glands sometimes inconspicuous or obsolete, stipules not seen; inflorescence ample, axillary and subterminal, the latter characteristically 15–30 cm. long, with a thin brown arachnoid tomentum which is at length deciduous, and overlies a fine uniform puberulence, branches densely flowered, the cymules borne on peduncles 2–5 mm. long, bracts 2–3 mm. long, broadly triangular-ovate, acute; flowers sessile, buds pentagonal toward the apex, calyx 2.5–3.0 mm. long, campanulate, somewhat narrowed toward the base, brownish to grayish short pilose, the lobes lanceolate, acutish, ca. 1.5 mm. long, externally short pilose and frequently also more or less conspicuously hirsute with longer upwardly directed hairs, the lobes apparently ascending or patent in anthesis, the tube densely longer villous within, densely so at the attachment of the filaments, apetalous, stamens 10–12, exserted, 2.0–2.5 mm. long, style thinly pilose below the middle, exceeding the stamens, ovary densely long villous; the young fruit globose, mature fruit ca. 1.8 diam., globose, glabrous, pericarp thick, corky, green, drying dark brown.

Type: tree, flowers white, forest, clayey soils, August 1924, Hope, British Guiana, *A. C. Persaud 95*. New York Botanical Garden. Cotypes: 20 ft. high, flowers white, between Demerara and Berbice Rivers, *La Cruz 1670;* tree 50 ft. high, 8 in. diam., leaves stiffly chartaceous, glaucous below, flowers in lax, branched terminal inflorescence, buds gray, flowers white, stamens exserted, Madray Landing, Essequibo River, British Guiana, *Fanshawe 1700* (F.D. 4436); tree 75 ft. tall, 12 in. diam., unbuttressed, from *Dicymbe* forest on white

sand, Mahdia River, Potaro River, 107 mile, Bartica-Potaro Road, *F1086* (F.D. 3822), immature; tree 80 ft. high, 14 in. diam., from mixed forest on brown sand, Mazaruni Station, *F1359* (F.D. 4095), in fruit. Known only from British Guiana.

Perhaps most closely related to *Licania Gardneri* of the state of Piauhy, Brazil (two isotypes at N. Y. Bot. Gard.), in which the leaves are relatively broader, totally glabrous, the petioles ca. 5 mm. long, densely and coarsely brown villous and eglandular, the inflorescence not tomentose, and the cymules sessile. Close affinity probably also lies with *Moquilea pallida* Hook. f. (apparently no legitimate epithete exists for this species under *Licania*), of which no authentic material has been seen. But a very clear photograph of the isotype, *Spruce 3302* from the Cassiquiari, which was deposited in the Berlin Museum, had very short inflorescences, considerably smaller leaves in which the midrib was deeply channelled and the primary veins strongly impressed on the upper surface; further, in the original description[53] the petioles are said to be "tomentose," the "Flores . . . brevissime pedicellati" (a character well seen in the photograph), and the "Calyx urceolaris, tomentosus, pauce lanuginosa."

LICANIA OCTANDRA (Hoffmgg. ex Roem. et Schult.) Kuntze. BRITISH GUIANA: tree 30 feet high, 4 inches diam., leaves chartaceous, thinly woolly beneath, flowers in terminal and axillary spicate inflorescence, white, buds and calyx gray-white, thinly woolly, stamens exserted, island, Kurihi Rapids, Essequibo River, *F1564* (F.D. 4300); Bootooba, *Persaud 97*. British Guiana, Brazil.

COUEPIA CANOMENSIS (Mart.) Benth. BRITISH GUIANA: tree 100 ft. high, 16 in. diam., unbuttressed basally swollen, leaves glaucous below, inflorescence axillary, pale brown covered with long brownish hairs, mature fruit ovoid-globose, woody, collected from the ground, from clump wallaba forest, on white sand, Mahdia River, Potaro River, 107 mile, Bartica-Potaro Road, *F1000* (F.D. 3736). With some hesitation referred here. Unrecorded from British Guiana; Amazonas, Brazil, reported from Peru.

COUEPIA CARYOPHYLLOIDES R. Benoist. SURINAM: tree 25 m. tall, 35 cm. diam., flowers white, early falling, wood hard, red, leaves pale beneath, Campo Dungeoman, some 10 km. above Boschlandia, Saramacca River, *24060*. French Guiana, Surinam. Questionably referred to the above poorly known species.

COUEPIA COGNATA (Steud.) Fritsch. BRITISH GUIANA: shrub to 4 ft. tall, leaves erect, fleshy, woolly beneath, fawn colored when young, inflorescence axillary, woolly, fawn colored, petals white, common on scrub savanna of Muri type, Ituni Road, Mackenzie, *F2489* (F.D. 5225). British Guiana, Surinam. This species reaches a height of 40 feet and diameter of 8 inches.

Couepia exflexa Fanshawe & Maguire, sp. nov. Arbor magna; ramulis glabris; folis oblongis, basibus obtusis vel acutis, apicibus abrupte acutis, supra postremo glabris, subtus compacte tomentosis, venis inconspicuis, stipulis non visis; inflorescentibus dense spicatis, floribus imbricatis, bracteis conspicuis, late deltoido-ovatis, acutis; tubis calycibus crassis, subligneis, valde exflexis; petalis ovatis vel suborbiculatis.

Tree at least 30 m. high and 30 cm. diam.; branchlets glabrous; leaf blades (10) 12–18 cm. long, 5–8 cm. broad, oblong, the base obtuse or acutish,

[53] Fl. Bras. 14[2]: 25. 1867.

terminally abruptly drawn to an acute apex less than 1 cm. long, the upper surface thinly tomentose, soon glabrescent, becoming at length completely glabrous, the lower compactly and thinly brownish tomentose, primary veins 14–16 making about a 45° angle with the midrib, secondary veins and veinlets obscured completely by the tomentum, petioles ca. 1 cm. long, thinly arachnoid tomentose, transversely rupturing, stipules not seen; inflorescence densely spicate, 3–5 cm. long, the flowers closely imbricate, bracts conspicuous, the lower ca. 8 mm. long, broadly deltoid-ovate, acute, somewhat keeled, pale, diminishing upwards, a pair of smaller but similar bracteoles subtending each flower; calyx tube 8–10 mm. long, 3 mm. diam., thick-walled, subligneous, strongly anteriorly distally recurved, glabrous within, densely short-villous, light brown externally, sepals white, ovate, acute, ca. 4 mm. long, petals ca. 5 mm. long, broadly ovate to suborbicular, short-pilose along the margins, stamens ca. 15, connate at the base, anteriorly inserted on the disk that is 2 mm. high, glabrous externally and densely hirsute internally, staminodes ca. 5, inserted posteriorly on the disk which is there ca. 2.5 mm. high, style rather thick, feebly hirsute-pilose below toward the base, ovary densely and softly short-pilose; fruit solitary, oblong-oval, or obovate, orange, 2.5 cm. long, 1.7 cm. broad.

TYPE: tree 90 ft. tall, 12 in. diam., under-surface of leaves sericeous to rusty-brown, flowers shortly spiked, calyx rusty silky hairy, reflexed, petals white, deciduous, from mixed forest, similar in habit and in wood to *Couepia bracteosa*, but grows to a big tree, Mazaruni Station, British Guiana, June 5, 1942, *Fanshawe 722* (F.D. 3458). New York Botanical Garden. Cotype: fruiting material, Mazaruni Station, December 11, 1942, *Fanshawe 722a* (F.D. 3458). Known only by the type collections.

A member of the *Bracteosa* group, our species is most closely related to *Couepia magnoliaefolia* Benth. ex Hook. f., in which the leaves are similar, but the bracts are short and inconspicuous, the calyx tube is ca. 6 mm. long, not reflexed, the 30 $\pm$ stamens disposed in a continuous cycle, and the style considerably more conspicuously hirsute.

COUEPIA HABRANTHA Standley. BRITISH GUIANA: tree 10 m. high, 10 cm. diam., leaves pale beneath, inflorescence pale brown, velvety, flowers white, rare, along Potaro River above Kaieteur Falls, *23363;* tree 10 m. high, 15 cm. diam., occasional high mixed forest, Potaro River Gorge below Kaieteur Falls, *23529*. Known previously only from the type, *Krukoff 7252*, from Amazonas, Brazil. Apparently *Ducke 661,* likewise from Amazonas, should go here.

COUEPIA MYRTIFOLIA Benth. BRITISH GUIANA: large unbuttressed tree, Mazaruni Station, *F242* (F.D. 2978), *F708* (F.D. 3444); Moraballi Creek, *F584* (F.D. 3220). The three collections listed above are somewhat variable among themselves, and seem most certainly to belong to the leptostachya-myrtifolia-thyrsiflora complex. Of the three it would seem that the last two, viz. *C. myrtifolia* and *C. thyrsiflora,* might be conspecific. Our specimens, at least for the present, are perhaps best referred to the inadequately understood *C. myrtifolia.* Previously unreported from British Guiana; Brazil. Fanshawe 584 and 708 with denser pubescence in the inflorescence may represent *C. versicolor* R. Ben., but *F242* and *Jenman 6580,* Demerara, are a good match for *Spruce 174,* the isotype of *C. myrtifolia* Benth., and *Spruce 2072,* both at the New York Botanical Garden.

COUEPIA PAUCIFLORA Huber. BRITISH GUIANA: tree 40 ft. high, 6 in. diam., from wallaba bush, Sandhills, Demerara River, *F902* (F.D. 3638). Additional (for earlier records see Sandwith, Kew Bull. **1931**: 376) records from British Guiana are: Pomeroon Dist., *La Cruz 1825;* Sandhill, *Persaud 142;* Northwest Dist., *La Cruz 3468;* Rockstone, *Gleason 539.* British Guiana, Pará, Brazil.

Couepia villosa Fanshawe & Maguire, sp. nov. Arbor parva; ramulis brevi-fulvo-villosis; foliis oblongo-oblanceolatis vel ellipticis, breviter acuminatis, supra sparce strigosis, glabratis, costis et venis lateralibus depressis, subtus pallidis fulvo-tomentulosis, conspicue, reticulatis, stipulis anguste linearibus, involutis, hirsutis, caducis; inflorescentibus paucifloribus, bracteis linearibus; floribus sessilibus; tubo calycis cylindrico, lobis lanceolatis, acutis vel acuminatis, petalis albis, sessilibus, oblongo-ovatis, obtusis, caducis; fructibus non visis.

Tree at least to 10 m. high; new branchlets appressed tawny short villous, branchlets of past season glabrate; leaf blades 8–12 cm. long, (3) 3.5–6 cm. broad, oblong-oblanceolate to elliptic, typically broadest above the middle, short to abruptly acuminate, the upper surface early sparsely strigose, soon becoming glabrous, the midribs and primary veins depressed, the undersurface tan-tomentulose, the prominent midrib and primary veins recurved towards the apex, transversely connected by prominent secondary veins, the ultimate forming a conspicuous reticulum; petioles 3–5 mm. long, thin, corrugated, glabrate, stipules 5–6 mm. long, narrowly linear, involute, hirsute, early caducous; inflorescence few (2–10) -flowered, densely short villous, tawny, lateral, or the flowers solitary, or occupying the lower nodes of a shoot that is terminally leafy, flower sessile, bracts linear, 2.5–4 mm. long, corolla slightly irregular, calyx tube cylindric, 8–12 mm. long, inconspicuously gibbose at the base, densely and stiffly short-villous, with hairs of several lengths, the longest strigose, outer sepals 6–7 mm. long, lanceolate, acute, strongly pubescent only on the median zone, petals ca. 6 mm. long, oblong-ovate, obtuse, white, sessile, very early caducous, stamens numerous, more or less 50, ca. 15 mm. long, reddish, sterile portion of staminal ring fimbriate, glandular, anthers white, ovary 2-ovuled, densely hirsute, a retrorsely pubescent band extending from the ovary to the base of the tube, style hirsute near the base; fruit not seen.

TYPE: tree 10 m. high, 12 cm. diam., petals and anthers white, mixed transition high-low bush, 0.5 km. southwest of Savanna I, 550 m. alt., Tafelberg, *Maguire 24782.* New York Botanical Garden. Known only by the type collection.

Similar to and most closely related to *C. pauciflora* Huber., from which it differs in relatively broader and abruptly terminating, thicker, and more conspicuously veined leaves, smaller immediately falling petals (those in *C. pauciflora* do not fall immediately upon the opening of the flower), the fimbriate, glandular sterile portion of the staminal ring, the somewhat smaller flowers, and most of all, in the close dense short villous pubescence of the inflorescence and flower which in *C. pauciflora* is thin, pale and definitely tomentose.

HIRTELLA ANGUSTISSIMA Sandw. BRITISH GUIANA: straggly tree to 13 m. high, 10 cm. diam., flowers white, filaments purple, frequent, river bank between Kangaruma and Amatuk, Potaro River, *23005;* straggly drooping tree

to 6 m. high, flower purple-blue, racemes pendent, frequent, river banks secondary scrub forest, Amatuk Portage, Potaro River, *23030,* topotype. Known only from the type locality.

Hirtella caduca Fanshawe & Maguire, sp. nov. Arbor parva; ramulis teretibus; foliis oblongis vel elliptico-lanceolatis, basibus cordatis, apicibus attenuato-lanceolatis, stipulis lanceolato-subulatis, planis, glandulosis, caducis; inflorescentibus axillaribus, racemosis subcorymbosis, bracteis bracteolisque lanceolato-subulatis, planis, acutis, glandulosis; sepalis oblongis vel elliptico-ovatis, acutis vel obtusis, extra sparse strigosis, intus dense sericeo-tomentulosis, petalis late oblongo-ovatis; ovariis glabris, apicibus comosis; fructibus elliptico-fusiformibus longitudinale costatis, sparce strigulosis.

Small tree reaching at least 8 m. in height and 8 cm. diam., branchlets terete, sparsely appressed-strigose or glabrescent, light grayish-brown, the lenticels raised, smooth, conspicuous, juvenile shoots thinly spreading, pale brown, hirsute; leaves mostly 6–9 cm. long, 2.5–3.0 (3.5) cm. wide, oblong to elliptic-lanceolate, base obtuse, cordate, the apex 1.0–1.3 cm. long, more or less abruptly attenuate-acuminate, finally blunt, bright green, subchartaceous, 5–6 (7) pairs of sparsely appressed-strigose primary veins, on the undersurface prominent, whitish, prominulous above, anastamosing at a distance of 2–4 mm. from the entire margins, juvenile leaves reddish-brown, more or less densely sericeous, quickly becoming glabrescent, petioles 2–3 (5) mm. long, coarse, strigose; stipules lanceolate-subulate, acutish, glandular, particularly so towards the base, early caducous; inflorescence axillary, racemose, 5–6 (7) cm. long, usually 10–15 flowered, subcorymbose, the buds greenish-black, thinly strigose; pedicels subfiliform, 12–17 mm. long (inclusive of axis below bracteoles), bracts and bracteoles lanceolate-subulate, acute, flat, thin, 2–3 mm. long, thinly strigose, glandular at the base, usually provided with a terminal gland, quickly caducous, calyx tube asymmetrically campanulate, 1.5–1.75 mm. long, sepals 5, ca. 4 mm. long, oblong to elliptic-ovate, the outer acutish, the inner obtuse, scantily strigose dorsally, densely sericeous tomentulose within, reflexed and somewhat revolute at anthesis, petals 5, white, 4–5.5 mm. long, broadly oblong-ovate, entire or somewhat retuse, abruptly short clawed, the claw ca. 0.5 mm. long, stamens 7, 10–12 mm. long, glabrous, pale and connate at the base, purplish distally, anthers suborbicular, deep purple-red, ca. 0.5 mm. long; ovary glabrous except for dense tuft of pubescence at summit, style about as long as the filaments, conspicuously pilose toward the base, otherwise glabrous, stigma minutely capitate, fruit ca. 2 cm. long, 6–7 mm. thick, narrowly elliptic-fusiform, longitudinally ribbed, very thinly appressed strigulose.

TYPE: tree 8 m. high, 8 cm. diam., flowers white, filaments mauve-purple; occasional, base Kaieteur escarpment, Potaro River, below Tukeit, May 16, 1944, *Maguire & Fanshawe 23498*. New York Botanical Garden, Cotype: riverside between Kangaruma and Amatuk, Potaro River, April 26, 1944, *Maguire & Fanshawe 23005a*. Known only from the Potaro River, British Guiana.

Hirtella caduca seems to be closely related to the recently described *H. macrosepala* Sandw.,[54] but in general form and appearance the two are dissimilar. Comparison of critical characters shows consistent and meaningful

[54] Kew Bull. 1939: 549.

quantitative differences. The qualitative differences of certain organs seem of particular significance, viz. leaf length-width ratio, stipules, bracts and bracteoles.

H. macrosepala	*H. caduca*
1. Leaf width-length ratio, 1: 2.7	1. Leaf width-length ratio, 1: 1.7
2. Stipules: "subulatae, persistentis, 3.5–4 mm. longae, . . . , demum coriaceae glabrae."	2. Stipules: lanceolate-subulate, early caducous, 4.5–5.5 mm. long, thin, conspicuously stipetate-glandular toward the base, scantily pubescent.
3. Bracts and bracteoles: "rigidae, coriaceae, oblongae, obtusae, fere semper revolutae, 1.5–2.75 mm. longae, ..."	3. Bracts and bracteoles: lanceolate-subulate, acute, flat, thin, 2–3 mm. long, thinly strigose, glandular at the base, early caducous.

HIRTELLA CILIATA Mart. & Zucc. BRITISH GUIANA: tree 30 ft. high, 6 in. diam., calyx crimson, petals white, fruit flattened oval or obovoid, purple-black, thinly fleshy, Orealla savanna, Courantyne River, *F2586* (F.D. 5374). British Guiana, Brazil. Apparently otherwise known from British Guiana only by *Schomburgk 113*, savanna near Perarara, Essequibo River, the type of *H. rubra* Benth.

HIRTELLA cf. *H. corymbosa* C. & S. ?*H. punctillata* Ducke. SURINAM: shrub to 3 m. high petals pink, filaments purple, fruit reddish, sparsely strigose, Savanna V, Tafelberg, *24392*.

Identification of this collection is not certain. Our specimens, from examination of Field Museum Photograph 3335, compare very closely to the type of *H. corymbosa*, "Brasilia austro-orientale: Sello 575." This species is described as having 3 stamens. The flowers of our material have 5. The Tafelberg specimens likewise compare very closely to the isotype of *H. punctillata* Ducke, Porto de Moz, Rio Xingú, Brazil, *Ducke 16663*. It would seem not improbable that the three collections represent a single species, which apparently is known only by these three cited exsiccatae.

HIRTELLA COTTICAËNSIS Kleinh. SURINAM: small tree 3–6 m. high, leaf petioles formicarious, cauliflorus from the base upwards, inflorescence congested, pubescence tawny, sepals green, petals pink, stamens purple, frequent, wallaba forest, Base Camp, Tafelberg Creek, *24103*. Closely allied to *H. physophora* Mart. & Zucc. from the upper Amazon Basin. The Surinam species differs in having short but distinctly petioled leaves, and the inflorescence less densely hirsute. *H. cotticaënsis* is known only from the type region.

HIRTELLA DAVISII Sandw. BRITISH GUIANA: tree 110 ft. tall, 2 ft. diam., fruit 15–20 mm. long, compressed, thinly strigose, locally frequent, mixed forest on stony lateritic soil, Kamuni Creek, Groete Creek, Essequibo River, *22912;* tree 80 ft. high, 12 in. diam., stamens 3, Groete Creek, *F1757* (F.D. 4493). Known only from the type locality Oko Creek, Cuyuni River, and the stations given above.

HIRTELLA GUYANENSIS (Fritsch) Sandw. BRITISH GUIANA: tree 70 ft. tall, 8 in. diam., unbuttressed, bark smooth, gray, slash dark crimson, hard, brittle, calyx bronze velvety, corolla lobes white, erect, caducous, filaments white, anther purple, stamens curved, fruit a flattened, oblong berry, bronzed, glossy purple-black when ripe, in low-lying miscellaneous forest on loam, Motokuru Creek, Essequibo River, *F306* (F.D. 3042). British Guiana.

HIRTELLA MACROSEPALA Sandw. BRITISH GUIANA: tree 50 ft. high, 8 in. diam., leaves glabrous, leathery, inflorescence terminal and axillary, petals white, early deciduous, sepals glossy green, mixed forest on brown sand, Mazaruni Station, B. G. For. Dept. *5344* (C.A.P. 35). Apparently known otherwise only by the type collection *Davis 2631* from Berbice River.

HIRTELLA MANIGERA Kleinh. BRITISH GUIANA: shrub to 2 m. high, 1–2 cm. diam., occasional mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22924;* tree 3 m. high, 2 cm. diam., flower spikes pendent, petals white, filaments crimson, occasional *Dicymbe* forest, trail from Tukeit to Kaieteur, *23514;* tree 10 ft. high, with spreading branches, *Eschweilera-Dicymbe* forest on lateritic soil, Eagle Mt., *F1119* (F.D. 3855). British Guiana, Surinam.

HIRTELLA PANICULATA Sw. SURINAM: small tree to 4 m. high, petals white, filaments light purple, frequent, Saramacca riverbanks below rapids, Jacob kondre, *23820*. West Indies, the Guianas and northern Brazil.

HIRTELLA RACEMOSA Lam. BRITISH GUIANA: tree to 10 m. high, 10 cm. diam., racemes pendent, buds dark green, petals pale violet, filaments purple, occasional, Potaro River banks above Kaieteur Falls, *23364;* tree 6 m. high, 10 cm., diam., racemes pendent, petals palest blue, filaments deep blue, occasional Dicymbe forest along trail from Tukeit to Kaieteur, *23515*. SURINAM: shrub, flowers lavender, infrequent Grasi Falls, Saramacca River, *24947*. Widely distributed in the American tropics from Central America and the West Indies to Brazil and Peru.

Hirtella subsetosa Fanshawe & Maguire, sp. nov. Arbor parva; ramulis teretibus, hirsutis; laminibus foliorum oblongo-ellipticis vel oblongo-lanceolatis, basibus late obtusis, minute cordatis, apicibus abrupte, acuminatis, subchartaceis, supra glabris, subtus sparce hirsutis, stipulis caducis, non visis; inflorescentibus racemosis, valde stramineo-subsetoso-hirsutis; bracteis bracteolisque triangulo-lanceolatis, glanduloso-dentatis, persistentibus; sepalis oblongo-ovatis, hirsutis, petalis oblongo-obovatis, staminibus 4; fructibus non visis.

Tree at least 7 m. tall and 15 cm. diam., branches drooping, branchlets slender, terete, spreading, hirsute; leaf blades mostly 8–12 cm. long, 3.5–5.5 cm. broad, oblong-elliptic, to oblong-lanceolate, rounded and minutely cordate, the apex abruptly acuminate, ca. 1 cm. long, subchartaceous, glabrous above, sparsely hirsute beneath, 7–9 pairs of prominent salmon-colored veins that anastamose 2–4 mm. from the margins, petioles 4–5 mm. long, reddish, hirsute, stipules apparently early falling, not seen; inflorescence racemose, axillary, 8–15 cm. long, strongly subsetosely-hispid with spreading dark stramineous transversely marked trichomes, bracts and bracteoles triangular-lanceolate, 2–4 mm. long, 0.5–1.5 mm. broad, more or less strongly glandular-dentate, the glands capitate or patelliform, borne on long, frequently broad based stalks, apparently more or less persistent, pedicels 4–5 mm. long, spreading, conspicuously hirsute; buds crimson-brown, calyx tube ca. 2 mm. long, globose-campanulate, bristly-hirsute with long and short hairs, as is the outer surface of the sepals, sepals ca. 4 mm. long, oblong-ovate, acutish, inside surface densely fulvo-sericeous and tomentulose; petals ca. 5 mm. long, oblong-obovate, short-clawed, white, stamens 4, connate at the base, 12–14 mm. long, crimson, deep purple when dry, pale towards the base, style somewhat shorter, pilose at the base; fruit unseen.

TYPE: tree 7 m. high, 15 cm. diam., drooping branches, flowers white, filaments crimson, buds brown-crimson, rare in wallaba forest, Kaieteur Plateau, British Guiana, *Maguire & Fanshawe 23437*. New York Botanical Garden. Known only by the type collection.

HIRTELLA VELUTINA Pilger. BRITISH GUIANA: tree 75 ft. tall, 14 in. diam., bushy-crowned, unbuttressed, bark like *Licania laxiflora,* leaves furry beneath, margins revolute, flowers in lax panicles, furry, whorls of deep crimson glandular hairs below each pair of flowers, calyx crimson, hairy, petals white, delicate, erect, dropping early, filaments long, white, stigma flushed with crimson, hairy, growing on slopes in greenheart forest, on stiff loam soil, Arawai Creek, Essequibo River, *F313* (F.D. 3049). British Guiana. Poorly known. The type, *Schomburgk 1051.* It is quite possible, as Ducke[55] concludes, that *H. velutina* is conspecific with *H. glandulosa* Spreng.

PARINARI EXCELSA Sabine. *P. brachystachya* Benth. BRITISH GUIANA: tree 100 ft. high, 32 in. diam., with spreading buttresses 6 ft. high, leaves chartaceous, glaucescent below, flowers in terminal corymbs, pedicels, buds and calyx sericeous, calyx lobes patent, mucronate, corolla lobes pale cream, deciduous soon after flowers open, mixed forest, lateritic hill slope, Siba Creek, *F660* (F.D. 3406); Mazaruni Station, *F611* (F.D. 3347). British Guiana and Brazil; also Africa.

PARINARI MONTANA Aubl. *P. lucidissima* Standl. BRITISH GUIANA: tree 120 ft. high, 24 in. diam., leaves felted below, nerves pale brown, margins involute, flowers in short corymbose panicles, all parts heavily felted, in threes subtended by paired bracts, calyx greenish-brown, corolla caducous, pale purple, staminal ring erect, mouth of calyx tube closed with a dense ring of hairs, Kokerite-Kabukallii forest on very light brown sand, Moraballi Creek, *F280* (F.D. 3016).

Fanshawe 280 must be considered conspecific with *Smith 3320,* Kanuku Mountains, British Guiana, the type of *Parinari lucidissima* Standl.[56] The Fanshawe collection further is inseparable from Guiana material that has been authoritatively referred to *P. montana* Aubl. It would seem necessary then to place *P. lucidissima* in synonymy under *P. montana.*

PODOSTEMACEAE[57]

WEDDELLINA SQUAMULOSA Tul. SURINAM: midrib and pedicels red, petals whitish, locally abundant, rocks in Gran Dam, Surinam River, *24925.* British, Dutch, and French Guiana.

APINAGIA SECUNDIFLORA (Tul.) Pulle. SURINAM: on floating log, Toekoemoetoe Creek, Saramacca River, *24912.* Puruni River, British Guiana, and Dutch Guiana.

APINAGIA PERPUSILLA Went. SURINAM: locally abundant, flat rock in Saramacca River, *24919.* Known from other rivers in Surinam.

OENONE RICHARDIANA (Tul.) Warm. SURINAM: locally abundant, flowers white or pale pink, rocks, Gran Dam, Saramacca River, *24923.* Known from the three Guianas.

Oenone penicillata van Royen, sp. nov. Flores solitarii, erecti in spathella ovoidea dispositi, zygomorphi; tepala 3, linearia, interdum 2 tepala

[55] Arch. Jard. Bot. Rio. 3: 266. 1922.
[56] Lloydia 2: 183. 1939.
[57] By G. van Royen.

addita, inde tepala 5 verticillata; stamina 2 cum tepalis alternantia; antherae extrorsae longitudinaliter dehiscentes. Ovarium 2-loculare, depresse 6-angulare; gynophora brevis; styli liberi basi dilatati, papillosi. Pollen 4-angulare, poris 4, praeditum, 20 mu longum. Fructus bivalvis valvis 3-costatis. Thallosa; folia vaginata; lamina pluries dichotome divisa segmentis capillaceis.

Thallus up to 1½ cm. Leaf up to 7½ cm. long. Spathella old, to 1 cm. long. Flower 2 mm., ovarium 1½ mm. high, stamina 2.2 mm. long. Fruit 2 mm. high.

TYPE: flowers whitish, locally abundant, rocks, Gran Dam, Saramacca River, Oct. 11, 1944, *Maguire 24927.*

The leaves resemble those of *Oenone Glaziovi* Warm., but otherwise differing from this last species by the presence of only 2 stamina, its smallness and the presence of a leaf-sheath.

MOURERA FLUVIATILIS Aubl. SURINAM: flowers pink, abundant, on rocks, riverside en route Kwatta hede to Tukosoe, Saramacca River, *23955;* flowers rose-pink, locally abundant on rocks, Saramacca River, *24949.* Known from the three Guianas.

MARATHRUM sp. BRITISH GUIANA: fruiting plant of previous season, brink Kaieteur Falls, *23219;* sterile vegetative material of current season, Kaieteur Falls, *23220.* Our specimens match *Jenman 7422,* Amatuk Falls, Potaro River, cited as *Rhyncholacis macrocarpa* Tul. by Engler.[58] *Jenman 7210,* upper Mazaruni River is a similar plant. Identified by Bassett Maguire.

MIMOSACEAE[59]

This report, following by eight years Kleinhoonte's floristic treatment of the Surinam Mimosaceae,[60] adds ten new records and two new species to the Guiana flora. The numbers in parentheses following specific names refer to the page in the Flora of Suriname on which the species is treated.

PARKIA OPPOSITIFOLIA Benth. SURINAM: frequent, buttressed tree 30 m. high, 8 cm. diam., inflor. 45–60 cm. long, peduncles terminating in dense constricted spikes, upper part staminate, lower pistillate, ♀ flowers rich yellow, maturing and elongating cream, ♂ flowers cream, opening mostly after ♀, primary jungle, Posoegronoe, Saramacca R., *24019.* Amazonian district and (according to Ducke) S. British Guiana. New to Surinam. It is rather surprising that both *P. oppositifolia* Benth. and the nearly allied *P. nitida* Miq. (the latter species frequent) occur in Surinam.

PARKIA PENDULA (Willd.) Benth. (263). SURINAM: frequent, tree to 40 m. tall, 1 m. diam., wood soft, bark thin flaking, reddish-brown, pod red, high mixed forest, near stream, North Ridge Cascade, Tafelberg, *24659.* Northern Brazil, British Guiana, Surinam. Probably throughout the country.

PARKIA ULEI (Harms) Kuhlm. (264). SURINAM: tree to 25 m. high, 40 cm. diam., flowers cream, bush to rear of Jacob kondre, Saramacca R., *23896.* Amazonian district, British Guiana. Frequently collected in the forest reserves of Surinam.

[58] Bot. Jahrb. **61.** Beibl. 138: 5. 1927.
[59] By G. Jane H. Amshoff.
[60] Flora Suriname **2:** 258–331. 1940.

ENTADA POLYPHYLLA Benth. SURINAM: small tree, flowers white, vicinity of Kwakoegron, Saramacca R., *25008.* Central America, West Indies, northern South America. In spite of the wide distribution, this is the first record for Surinam.

MIMOSA MYRIADENA Benth. (278). SURINAM: climber, riverside, vicinity of Pakka Pakka, Saramacca R., *23960*x; scandent shrub, climbing to 8 m., flowers white, riverbanks above Kwatta hede, Saramacca R., *23934.* Northern South America. Probably throughout the country.

MIMOSA PLUMAEIFOLIA Reinh. (281). SURINAM: frequent, slender shrub to 3 m., sensitive plant, flowers white, islands in Brokoboto Rapids, 3 hours above Pakka Pakka, Saramacca R., *23985;* frequent, slender diffuse shrub to 4 m., flowers white, islands in rapids, Saramacca R., *23997.* An armed, possibly endemic, species representing in Surinam the nearly allied, unarmed *M. microcephala* Willd.

MIMOSA POLYDACTYLA H.B.K. (280). SURINAM: perennial herb to 1.5 m., flowers white, riverbanks above village of Kwatta hede, Saramacca R., *23944.* Northern South America. Probably throughout the country.

INGA MYRIANTHA Poepp. et Endl. SURINAM: small tree, flowers white, 3 km. above Boschland, Saramacca R., *24044.* Amazonian district, British Guiana. First record for Surinam. To this species also belongs *Pulle 330* from the Coppenam R., named *I. umbellifera* (Vahl) Steud. in the Flora of Suriname (295). The latter species apparently does not occur in Surinam; the second specimen cited (by a typographical error), *Kappler 70* (*L.*), belongs to *I. coriacea* (Pers.) Desv.

INGA CORIACEA (Pers.) Desv. (297). BRITISH GUIANA: common, tree to 70 ft. high and 25 cm. diam., fruit yellow, cotyledons black, testa woody, seed coat white, sweet, riverbank between Kangaruma and Amatuk, Potaro R., *23007.* SURINAM: tree 20 m. high, 40 cm. diam., flowers white, 5–10 km. above Boschland, Saramacca R., *24054.* Amazonian district, Guiana. Probably throughout the country.

INGA CINNAMONEA Benth. SURINAM: Voltzberg, virgin forest, *Lanjouw 910.* Amazonian district. New to Guiana.

INGA BOURGONI (Aubl.) DC. (309). SURINAM: frequent, small tree, flowers white, bush to rear of Jacob kondre, Saramacca R., *23855.* Venezuela, Amazonian district, Guiana. Throughout the country.

Inga leptingoides Amsh., sp. nov. Arbor parva glaberrima. Ramuli lenticellosi. Stipulae ingotae. Foliorum petiolus et rachis late alatus; glandulae orbiculares magnae concavae; foliola 2-juga, brevissime petiolata, oblonga, basi obtusa, apice breviter obtuse acuminata vel obtusa, coriacea, nitida, 6–13 cm. longa, 2.5–5.0 cm. lata, costa utrinque leviter elevata, nervis utrinque prominulis; venis laxe reticulatis. Pedunculi axillares solitarii, 2.5–3.0 cm. longi; inflorescentia racemosa, rachi ± 5 mm. longa subclaviforme; bracteis minimis deciduis vix 0.5 mm. longis; pedicellis ± 2 mm. longis. Flores glabri; calyx campanulatus breviter 5-dentatus, 1.0 mm. longus; corolla 4 mm. longa, breviter tubulosa apice dilatata; staminorum tubus vix exsertus. Legumen ignotum.

TYPE: tree to 10 m. tall, 15 cm. diam., flowers white, low bush, vicinity of Savanna II, Tafelberg, Surinam, August 9, 1944, *Maguire 24264.* New York Botanical Garden. Also represented by *Maguire 24640* from Tafelberg, flowers white, opening in Clusia bush, camp no. 2 to s. w. escarpment.

Apparently nearly allied to *I. Ulei* Harms (syn. *I. racemiflora* Ducke. I could compare type duplicates of both species, respectively preserved in the Leiden and in the Utrecht herbaria). Like *I. Ulei* Harms, *I. leptingoides* is, by its glabrous, shortly racemose small flowers, intermediate between the sections *Leptinga* Benth. and *Burgonia* Benth. In *I. Ulei* Harms, however, the leaves are but one-jugate, the petiole hardly winged, the corolla longer.

INGA STIPULARIS DC. (307). SURINAM: frequent, flowers white, stipules conspicuous, high bush, south cliffs Arrowhead Basin, Tafelberg, *24450*. Amazonian district, Guiana. Probably throughout the country.

INGA THIBAUDIANA DC. (299). SURINAM: frequent, 10 m. tall, 12 cm. diam., flowers white, precipitous east facing slopes above escarpment, 300 m. south of east ridge, Tafelberg, *24549*. Brazil, Guiana, Venezuela, Ecuador. Common throughout the country.

INGA NOBILIS Willd. (306). SURINAM: frequent, 12 m. tree, 10 cm. diam., flowers white, riverbank below rapids, Jacob kondre, Saramacca R., *23842;* tree to 6 m. high, 20 cm. diam., fruit ca. 5 cm. long, yellow, bush to rear of Jacob kondre, Saramacca R., *23852;* vicinity of Posoegronoe, *24040;* small tree, flowers white, 5–10 km. above Boschland, *24045;* flowers white, along river between Kwatta hede and Jacob kondre, *24952*. Northern South America. Throughout the country.

INGA ACROCEPHALA Steud. (305). SURINAM: tree to 15 m. tall, 30 cm. diam., bush to rear of Jacob kondre, Saramacca R., *23888;* tree 15 m. high, 3 dm. diam., flowers white, forest near Tafelberg Creek, Base Camp, *24121*. Known only from Surinam.

INGA SPLENDENS Willd. (301). SURINAM: 12 m. high, 15 cm. diam., above escarpment, 300 m. south of East Ridge, Tafelberg, in mixed high bush, *24549a;* tree 5 m. tall, 20 cm. diam., leaves glossy green, tough, flowers white, Campo Dungeoman, *24059*. Eastern Amazonian district, Venezuela, Guiana. Common throughout the country.

INGA COMMEWIJNENSIS Miq., Stirp. Sur. Sel. (1850) p. 1; *Inga Prieurii* Sagot, Ann. Sc. Nat. VI 13 (1882) p. 13. Surinam and French Guiana. Compared with a duplicate type of *I. Prieurii* Sagot, preserved in the Leiden herbarium.

INGA CAYENNENSIS Sagot ex Benth. SURINAM: frequent, tree 15 m. high, 25 cm. diam., pubescent twigs, leaves tawny, viscid, flowers white, pubescent, calyx white, mixed high forest, hill no. 1, Tafelberg, *24709*. Amazonian district, French Guiana. New to Surinam.

Inga calanthoides Amsh., sp. nov. Arbor. Ramuli dense fusco-pubescentes. Stipulae ignotae. Foliorum rachis petiolus anguste marginatus; rachis late alata; glandulae parvae elevatae; foliola (3–) 4-juga, brevissime petiolulata, oblonga vel obovato-oblonga, apice acute acuminata, base obtusa vel rotundata, usque ad 11 cm. longa et 5 cm. lata, coriacea, supra sparsius subtus densius pubescentia, costa utrinque dense pubescente; nervis supra impressis subtus prominentibus. Pedunculi axillares saepius bini, breves (0.5–1.5 cm. longi); inflorescentia racemosa floribus inferioribus pedicellatis floribus superioribus sessilibus, pauciflora, laxa, 10 cm. longa, dense fusco-pubescens; bracteae ovatae concavae ± 2.5 mm. longae demum deciduae; pedicelli usque ad 6 mm. longi. Flores circiter 4 cm. longi; calyx tubulosus apice parum dilatatus ± dense pubescens, striatus breviter 5-

dentatus dentibus triangularibus, ± 18 mm. longus; corolla dense satis longe pubescens; staminorum tubus breviter exsertus. Legumen planum oblongum dense fusco-pubescens 15 cm. longum, 3 cm. latum.

TYPE: frequent, tree 15 m. tall, 18 cm. diam., flowers white, leaves and fruit tawny-pubescent, in dakama forest, 1 km. n. w. of East Ridge, Tafelberg, Surinam, August 29, 1944, *Maguire 24547*. New York Botanical Garden.

The species belongs to the series *Longiflorae* of the section *Pseudinga* Benth. and is characterized in this group by its short lax inflorescences, pedicellate flowers, short triangular calyx teeth and shortly exserted staminal tube. *I. calantha* Ducke, with sessile flowers, setaceous calyx teeth and long exserted staminal tube is closely allied. *A. C. Smith 3446*, fr. from the Kanuku Mountains, British Guiana, may belong to *I. calanthoides*, but flowers are wanting and the indumentum is slightly longer.

Only one other species of the series *Longiflorae* has been found in Surinam. In the absence of flowers, the specimen was tentatively referred to *I. velutina* (Poir.) Willd. (298). It is at any rate distinct from *I. calanthoides* Amsh. by its dense spikes.

PITHECELLOBIUM (*Zygia*) CAULIFLORUM (Willd.) Benth. (314). SURINAM: small tree, profusely blooming, flowers pink, riverbanks above Kwatta hede, Saramacca R., *23958*; frequent, flowers pink, along Tafelberg Creek, vicinity of Base Camp, *24105*. Brazil, Guiana. Common throughout the country.

PITHECELLOBIUM (*Zygia*) GLOMERATUM (DC.) Benth. (315). SURINAM: tree 10 m. high, 20 cm. diam., flowers white, riverbanks above Kwatta hede, Saramacca R., *23941*; tree 3 m. tall, stems tough, flexible, flowers green, used for fish traps and general house building, vicinity Brokolonka, Saramacca R., *23798*. Amazonian district, Venezuela, Guiana. Throughout the country.

PITHECELLOBIUM (*Zygia*) HUBERI Ducke. SURINAM: border of virgin forest, Coppenam R., *Went 121*; Bergendall, riverside, *Focke 1300*; Watramiri, B.W. *5392* (not belonging to the tree no. 1686 = *P. cauliflorum* (Willd.) Benth.). Pará. First record for Guiana. Confused with *P. glomeratum* (DC.) Benth., which is quite distinct by the more numerous, more spreading lateral nerves of the leaflets. *P. Huberi* Ducke differs from *P. cauliflora* (Willd.) Benth. by its glabrous leaf-rachis and shortly spicate flowers.

PITHECELLOBIUM (*Zygia*) LATIFOLIUM (L.) Benth. (316). BRITISH GUIANA: frequent, tree to 12 m. high, 10 cm. diam., flowers pink, high forest, Kamuni Creek, Groete Creek, Essequibo R., *22879*. Central America, West Indies, Guiana, N. Brazil. Throughout the colony.

PITHECELLOBIUM (*Abarema*) JUPUNHA (Willd.) Urb. (318). BRITISH GUIANA: occasional, small tree to 8 m. high, 12 cm. diam., flowers white, fruit red inside, seed blue, from bush island on savanna, tree grows to 120 ft. in height and 4 ft. in diam. in lowlands, Kaieteur Plateau, *23139*. SURINAM: tree 30 m. tall, 7 dm. diam., flowers white, pods semicircular or more curved, pod red-orange inside, seed blue, high mixed forest near stream, North Ridge Cascade, Tafelberg, *24660*. Northern South America. Common throughout Surinam.

PITHECELLOBIUM (*Abarema*) VILLIFERUM Ducke. SURINAM: frequent, tree 8 m. high, 12 cm. diam., flowers white, pubescence tawny, opening in

Clusia bush, Savanna VIII to s. w. escarpment, Tafelberg, *24629*. New to Surinam; hitherto known only from the type collection (Amazonas). I could compare a duplicate of the type, which has slightly smaller flowers but is otherwise a perfect match for the Tafelberg specimen.

PITHECELLOBIUM (*Arthrosamanea*) CORYMBOSUM (Rich.) Benth. (327). BRITISH GUIANA: occasional, tree 5 m. high, 6–8 cm. diam., leaves finely divided, fruit greenish, septate, brittle, along Potaro R. above Kaiatuk, *23371*. SURINAM: tree to 20 m. high, 25 cm. diam., flowers cream, along railroad near km. 70, *23639;* tree to 15 m. tall, 15 cm. diam., ♂ flowers greenish, ♀ flowers white, 5–10 km. above Boschland, Saramacca R., *24047*. Amazonian district, Guiana, Venezuela; probably throughout Surinam.

PITHECELLOBIUM (*Arthrosamanea*) GONGGRIJPII Kleinh. (328). SURINAM: frequent, tree to 20 m., 25 cm. diam., corolla orange-red, filaments and style whitish, along stream, vicinity Camp 5, Coppenam R. Headwaters, *25060;* frequent, tree to 15 m. high, 30 cm. diam., flowers white, low bush north to Savanna I, Tafelberg, *24273*. British Guiana, Surinam; probably throughout the colony but apparently not common.

PITHECELLOBIUM (*Chloroleucon*) ACACIOIDES Ducke. SURINAM: Gonini R., *Versteeg 4*. Northern and central Brazil. New to Surinam; perhaps also in French Guiana.

Ducke distinguished *P. acacioides* Ducke from the nearly allied *P. mangense* (Jacq.) Macbr. (syn. *P. parvifolium* (Sw.) Benth.) chiefly on account of its cochleate pod. Though in the Surinam specimen no fruits are present, I was through the courtesy of the director of the Paris herbarium able to study the following specimens from Fr. Guiana, formerly determined as *P. parvifolium* (Sw.) Benth.: Rivage de la mer a l'embouchure du Maroni, *Sagot 170;* Kourou, *Benoist 171;* without locality, *Le Prieur* anno 1850. In *Sagot 170* fruits are present; these are cochleate, and the specimens belong therefore to *P. acacioides* Ducke.

PITHECELLOBIUM (*Cojoba*) sp. BRITISH GUIANA: rare, tree to 140 ft. high, 5 ft. diam., mixed forest, banks and swamps along Kamuni Creek, Groete Creek, Essequibo R., *22950*. No species of this group of *Pithecellobium* has as yet become known from Guiana; flowers are wanted.

ENTEROLOBIUM SCHOMBURGKII Benth. (324). SURINAM: tree 30 m. tall, 8 dm. diam., flowers white, fruit reddish-brown, flat spiral, high mixed forest, vicinity stream, North Ridge Cascade, Tafelberg, *24664; 24664b*. Brazil, Guiana, Central America. In Surinam hitherto known only from the forest reserve Brownsberg.

CALLIANDRA TERGEMINA (L.) Benth. (322). SURINAM: locally common, arching tree to 10 m. high, 15 cm. diam., several stemmed, calyx greenish, filaments deep pink, boulder-filled stream below Hendrik Creek, Coppenam R. Headwaters, *25068*. Amazonian district, Guiana, Venezuela, West Indies. Probably throughout the country.

CAESALPINIACEAE[61]

Page references are made to the writer's treatment of the family in the Flora of Surinam.[62] Three new species, one new variety and three new records are added to the known flora of the Guianas.

[61] By G. Jane H. Amshoff.

[62] Flora Suriname 2: 1–104. 1939.

DIMORPHANDRA HOHENKERKII Sprague & Sandw. (10). SURINAM: frequent, tree to 20 m. high, 25 cm. diam., flowers orange-brown, low forest near Camp 5, Coppenam R. Headwaters, *24197;* frequent, tree to 10 m. high, 10 cm. diam., flowers orange-red, border of low brush south of Savanna I, Tafelberg, *24365*. British and French Guiana; in Surinam hitherto known only from one collection.

DIMORPHANDRA CONJUGATA (Splitg.) Sandw. (11). SURINAM: frequent, savanna shrub to 4 m. high, tree in high bush, Zanderij I, *23737*. Throughout Guiana, locally common.

DIMORPHANDRA CUPREA Sprague & Sandw. BRITISH GUIANA: frequent to common, tree to 8 m. high, leaves finely divided rusty tomentose below when young, flowers yellow, inflorescence rusty-tomentose, Kaieteur savanna, *23195*. Known only from the Kaieteur savanna.

CYNOMETRA MARGINATA Benth. (16). SURINAM: Posoegronoe, Saramacca R., *24010;* small tree, flowers white, 10 km. above Boschland, Saramacca R., *24040a;* tree, 20 m. high, 35 cm. diam., leaves glossy green, flowers white, fruit immature, bush to rear of village Jacob kondre, Saramacca R., *23856*. Guiana.

COPAIFERA GUYANENSIS Desf. (18). SURINAM: frequent, tree 30–40 m. high, 1 m. diam., peduncles erect, copious oily sap used by bush negroes as laxative, riverbanks below rapids, Jacob kondre, Saramacca R., *23836;* tree to 20 m. high, 50 cm. diam., flowers white, inflorescence erect, primary jungle near village of Posoegronoe, Saramacca R., *24015*. Guiana, Rio Negro. Common throughout the country.

CRUDIA AROMATICA (Aubl.) Willd. (20). SURINAM: overhanging Tafelberg Creek, km. 10, *24903*. French Guiana (known otherwise only from Brownsberg). The flowers of Maguire's specimen are somewhat smaller and the racemes shorter than in the only other flowering specimen preserved.

PELTOGYNE VENOSA (Vahl) Benth. (26). SURINAM: frequent, tree overhanging river, flowers white, along Saramacca R. between Pakka Pakka and Kwatta hede, *24951;* large tree, flowers white, riverbanks between Jacob kondre and Kwatta hede, Saramacca R., *23907*. Throughout Guiana.

EPERUA RUBIGINOSA Miq. var. GRANDIFLORA Pulle (31). SURINAM: frequent, tree to 20 m. high, 25 cm. diam., corolla and filaments red, riverbanks below rapids, Jacob kondre, Saramacca R., *23804*. The species in Guiana and Pará; the variety known only from Surinam.

EPERUA FALCATA Aubl. (29). SURINAM: frequent, buttressed tree 40 m. high, 2 m. diam., fruit red, mixed high forest, diabasic soil, hill no. 1, Tafelberg, *24720;* frequent, wallaba tree 40 m. high, 2 m. diam., buttressed, flowers pink, mixed high forest, base of north escarpment, Tafelberg, *24778*. Guiana; common throughout the country.

MACROLOBIUM BIFOLIUM (Aubl.) Pers. (35). SURINAM: monopetalous, petal white, overhanging Tafelberg Creek, km. 5, Saramacca R., *24895*. Guiana, Amazonian district. Throughout the country.

MACROLOBIUM BIFOLIUM (Aubl.) Pers. var. **amplexans** Amsh., var. nov. **A typo differt indumento inflorescentiae tenuiore, unge vexilli basi dilatato-subbiauriculata, stipitem ovarii amplexante.**

TYPE: frequent, tree 40 m. high, 1 m. diam., wood exceedingly hard, heart red, sap white, flowers monopetalous, petal white, stamen red, high

bush north Savanna I, Tafelberg, Surinam, August 11, 1944, *Maguire 24308*. New York Botanical Garden.

MACROLOBIUM CHRYSOSTACHYUM Miq. (34). SURINAM: tree 20 m. high, 30 cm. diam., corolla white, filaments red, base green, anthers dark purple, primary jungle near Posoegronoe, Saramacca R., *24016;* tree, petals white, overhanging Toekoemoetoe Creek, *24910*. Guiana, Amazonian district. Throughout the country.

MACROLOBIUM HUBERIANUM Ducke var. **pubirachis** Amsh., var. nov. A typo differt rachide inflorescentiae pubescente (sed indumento haud homogeneo) ovario ad suturas piloso.

TYPE: occasional to frequent, tree to 6 m. high, 10 cm. diam., inflorescence reddish, petals white, stamens crimson, Kaieteur Plateau, Potaro R. below Tukeit, British Guiana, May 16, 1944, *Maguire & Fanshawe 23507*. New York Botanical Garden. Other specimen: occasional to frequent, tree to 4 m. high, 4 cm. diam., fruit green, full but not ripe, Potaro R. below Tukeit, *23491*. The species is known only from the Brazilian state of Pará.

Macrolobium stenopetalum Amsh., sp. nov. Frutex vel arbor parva; ramulis glabris. Stipulae deciduae, non visae. Folia glaberrima; petiolus 3–5 mm. longus; foliola bijuga, subsessila, falcato-oblonga, acuminata, coriacea, 3–8 cm. longa, 1.5–2.5 cm. lata, nervo marginale marginem valde approximato. Racemi solitarii, glabri, laxi, 3–6 cm. longi; bracteae triangulares, minimae; pedicelli usque ad 1 cm. longi; bracteolae ovatae, membranaceae, glabrae, ± 1 cm. longae, haud reflexae. Flores speciosi; receptaculum campanulatum, ± 3 mm. altum; sepala 4 inaequalia, ± 6 mm. longa, bracteolis subaequilonga, apice breviter pubescentia, uno latissimo apice 2-dentato, ceteris angustioribus acuminatis; petalum breviter exsertum, ungue piloso in lamen angustum vix 2 mm. latum transiente; filamenta pilosa; ovarium subglabrum 2-ovalatum. Legumen planum oblongum dehiscens, suturis vix dilatatis, 10 cm. longum, 4 cm. latum; semina 2.

TYPE: frequent, shrub or small tree to 10 m., flowers red, Tafelberg, Savanna IV, Surinam, September 17, 1944, *Maguire 24792*. New York Botanical Garden. Cotypes: infrequent, shrub 1.5 m. high, bracts and sepals red, corolla white, Savanna II, Tafelberg, *24232;* shrub to 3 m. high, flowers red, grass sedge opening, Savanna IV, 520 m. alt., Tafelberg, *24375*.

The nearly allied *M. pendulum* Vog. ex Benth. differs by its shorter sepals, broader petal, glabrous filaments, shorter pod and the more arcuate lateral nerves of the leaflets.

Macrolobium longeracemosum Amsh., sp. nov. Arbor parva (?), ramulis puberulis glabrescentibus lenticellosis. Stipulae deciduae non visae. Folia usque ad 8 cm. longa; rachis inter juga regulariter subalato-dilatata, sparse pubescens; foliola 10–18-juga, lineari-oblonga apice emarginata, striatovenosa, coriacea, costa subtus puberula excepta glabra, usque ad 2 cm. longa 6 mm. lata, moderate decrescentia. Inflorescentia ± 12 cm. longa, cano-pubescens; flores ignoti; pedicelli fructifera ± 3 mm. longi, canopubescentes. Legumen oblongum planum stitite pubescente ± 6 mm. longa praeditum ± 8 cm. longum 2.5 cm. latum subglabrum.

TYPE: frequent, overhanging Augustus Creek, Tafelberg, Surinam, September 6, 1944, *Maguire 24650*. New York Botanical Garden.

The flowers are unfortunately unknown, but because of its long ra-

cemes the species is a very distinct one, probably allied to *M. brevense* Ducke and *M. venulosum* Benth.

Since the collection of Maguire has added three species to the number (now 9) of *Macrolobium* species known from Guiana, the following key may be offered:

1a. Leaves 2-foliate .... 2.
b. Leaves 4 or more foliate .... 5.
2a. Inflorescence pubescent; flowers shortly (up to 4 mm.) pedicellate; upper suture of the pod dilated .... 3.
b. Inflorescence glabrous, lax; pedicels ± 1 cm.; sutures of the pod hardly dilated; petal very narrow .... *M. stenopetalum* Amsh.
3a. Bracts as large as the bractlets; leaflets long acuminate. Throughout Guiana. *M. chrysostachyum* Miq.
b. Bracts minute, very deciduous; leaflets mostly acute or shortly acuminate .... 4.
4a. Inflorescence pubescent; claw of the petal narrow, not dilated. Throughout Guiana .... *M. bifolium* (Aubl.) Pers.
b. Inflorescence finely puberulous; claw of the petal dilated-suriculate at base. *M. bifolium* (Aubl.) Pers. var. *amplexans* Amsh.
5a. Leaflets 3–8-jugate, oblong or ovate, at least 1 cm. wide .... 6.
b. Leaflets 10–20 jugate, linear-oblong, emarginate at apex, 4–7 mm. wide .... 8.
6a. Racemes glabrous .... 7.
b. Racemes brown velutinous; leaflets 5–6 jugate, oblong-lanceolate, acute; not seen. British Guiana .... *M. Jenmani* (Gleas.) Sandw.
7a. Leaflets 4, ovate, obtuse. French Guiana, Surinam (known from but two collections) .... *M. guianense* (Aubl.) Pulle
b. Leaflets 3–8, oblong, retuse to obcordate; pod suborbiculate, indehiscent. Throughout Guiana .... *M. multijugum* (DC.) Benth.
8a. Inflorescence lax, ± 8 cm. long; pedicels ± 6 mm.; leaflets reticulate-veined. British Guiana .... *M. Huberianum* Ducke
b. Pedicels very short, 2–3 mm.; inflorescence pubescent .... 9.
9a. Leaflets striate-veined; inflorescence ± 12 cm. long; pod oblong, probably dehiscent. Surinam .... *M. longeracemosum* Amsh.
b. Leaflets reticulate-veined; inflorescence very short; pod suborbiculate; indehiscent. Probably throughout Guiana (not yet known from French Guiana). *M. acaciaefolium* Benth.

HETEROSTEMON OTOPHORUS Sandw. BRITISH GUIANA: common to abundant, small tree to 10 m. high, 10 cm. diam., flowers large, white, fruit red when young, green when ripe, Garraway Stream, Potaro R., *22981*. Endemic; twice before collected in the same region.

BAUHINIA ACALA-SIMIAE Sandw. BRITISH GUIANA: occasional, rope with deeply divided stem, inflorescence, pedicels, nerves beneath rusty-tomentose, fruit glaucous, green, pods flat, Potaro R., above Kaiatuk, *23367*. Known only from British Guiana.

CASSIA QUINQUANGULATA Rich. (60). BRITISH GUIANA: common, vine in opening rope 6 cm., dense second growth in windfall opening, heavy mora forest, Kamuni Creek, Groete Creek, Essequibo R., *22867*. SURINAM: rope 3 cm. diam., flowers yellow, along railroad near km. 70, *23620*. Brazil, Guiana, Venezuela. Throughout the colony.

CASSIA OCCIDENTALIS L. (63). SURINAM: forming low thickets, weedy areas, riverbanks above Jacob kondre, Saramacca R., *23893a*. Pantropic, a common weed.

CASSIA MULTIJUGA Rich. (65). SURINAM: flowers yellow, overhanging Toekoemoetoe Creek, *24911*. Brazil, Guiana. Common throughout Surinam.

CASSIA LUCENS Vog. (60). SURINAM: frequent, tree to 10 m. high, 10 cm. diam., petals bright yellow, claws orange, staminodes and filaments white, anthers yellow, auricles minute, orange, sepals translucient-varnished, green-yellow, rapids along river between Grasi Falls and Posoegronoe, Saramacca R., *23995*. British Guiana, Brazil, Peru. Probably throughout the country, but seldom collected.

CASSIA LATIFOLIA G. F. W. Meyer. (60). BRITISH GUIANA: occasional, rope growing shrubby in open, flowers yellow, young fruit green, Kaieteur savanna, *23383*. Guiana, Pará. Probably throughout the colony.

CASSIA RETICULATA Willd. (69). SURINAM: frequent, perennial, 4 m., along Saramacca R. above Jacob kondre, *23893*. Northern South America, Central America. Probably throughout the country, but apparently not common in Surinam.

CASSIA TETRAPHYLLA Desv. var. RAMOSA (Vog.) Amsh. (74). SURINAM: flowers yellow, south savannas, vicinity Arawak village of Mata, *24959;* slender spreading shrub 1 m. diam., savanna Zanderij II, *23657*. Brazil, Guiana, Colombia. In savannas throughout the country.

CASSIA GLANDULOSA L. var. SWARTZII (Wikstr.) Macbr. (76). SURINAM: frequent, annual, sensitive plant, flowers yellow, islands in Brokotoko Rapids, 3 hours above Pakka Pakka, Saramacca R., *23987*. West Indies; rare in Surinam, probably intergrading with *C. stenocarpa* Vog.

CASSIA PATELLARIA DC. (78). SURINAM: frequent, annual, Charlesburg Rift, old sea beach, deep sands underlain by shells, 100 m. wide, shrub type, bordered by swamps and primary jungle, 3 km. north of Paramaribo, *22755*. Tropical America. In open country, probably throughout Surinam.

CASSIA APOUCOUITA Aubl. BRITISH GUIANA: mixed forest, Tukeit, Potaro R. Gorge, *26170*. Brazil, French Guiana. The species is cited for British Guiana in the Index of the Jenman herbarium.

RECORDOXYLON AMAZONICUM (Ducke) Ducke. BRITISH GUIANA: frequent, tree to 90 ft. high, 20 in. diam., unbuttressed, flowers yellow, buds, inflorescences, calyx yellow-brown, mixed forest, Tukeit, Potaro R. Gorge, *23050; 23050B*. Amozonas; new to British Guiana.

TACHIGALIA PANICULATA Aubl. (89). SURINAM: petals pale yellow, overhanging Tafelberg Creek, *24896*. Guiana, Amazonian district. Common throughout Surinam.

TACHIGALIA PUBIFLORA Benth. BRITISH GUIANA: occasional to frequent, tree to 6 m. high, 8 cm. diam., fruit elliptical, flat, glaucous, green when nearly ripe, seed flat, brown, reticulate, Potaro R. below Tukeit, *23483*. Known only from British Guiana.

DICYMBE JENMANI SANDW. BRITISH GUIANA: occasional, tree to 6 m. high, 6 cm. diam., leaves tomentose beneath, inflorescence and calyx rusty-velvety, flowers white, fruit rusty-velvety, Kaieteur savanna, *23157*. Known only from the Kaieteur Savanna.

SWARTZIA BENTHAMIANA Miq. (96). SURINAM: frequent, tree 20 m. tall, 30 cm. diam., bark thin, sap purple-red, petals pink-lavender or white, high mixed wallaba forest, km. 25, south of base Tafelberg, *24823; 24824;* mixed high wallaba forest, km. 18.5, line between camps 5 and 4, Coppenham R. Headwaters, *24828*. French Guiana; throughout the country.

SWARTZIA REMIGER Amsh. (97). SURINAM: tree 15 m. tall, 25 cm. diam., trunk deeply 4-winged, flowers monopetalous, petal white, overhanging stream, North Ridge Cascade, Tafelberg, mixed high forest, *24666;* frequent, tree 20 m. tall, 15 cm. broad, narrowly flanged, thickest portion of trunk no more than 12 cm., paddle wood, high mixed wallaba forest, lateritic soil, km. 8, vicinity Camp 3, Coppenam R. Headwaters, *24864*. Known only from Surinam; previously collected in the forest reserves Sectie O and Brownsberg. Now for the first time collected with adult flowers. The calyx splits into 4–5 irregularly formed segments, which are glabrous inside and about 1 cm. long. The petal has unfortunately not been preserved in the open flowers. The distinguishing characters against *S. polyphylla* DC. are all confirmed.

I had published this species as *S. remigifer*, but have since learned that the correct spelling is *remiger*.

SWARTZIA GRANDIFOLIA Bong. var. LEIOGYNE Sandw. BRITISH GUIANA: rare to occasional, 16 m. tree, 30 cm. diam., trunk and limbs knobby, cauliflorous, sepals 4, petal crisped, yellow, striated mauve, from wallaba bush, Kaieteur Savanna, *23314;* rare, tree to 14 m. tall, 25 cm. diam., flower buds golden, cauliflorous, high mixed forest, *23526*. The variety known only from British Guiana, the species in Guiana and the Amazonian district.

SWARTZIA ERIOCARPA Benth. BRITISH GUIANA: rare, tree to 6 m. tall, 10 cm. diam., leaves glaucous beneath, fruit orange, seed black and white (the arillus), wood coralline, Potaro R. below Tukeit, *23192*. Endemic.

SWARTZIA BRACHYRACHIS Harms (forma glabrata). BRITISH GUIANA: slender tree 20 m. high, fruit bright orange, British boundary, Akarai Mts., *A. C. Smith 2993* fr. Jan.; tree 7 m. high, fruit becoming orange, along Kuyuwini R. (Essequibo R. tributary) about 150 miles from mouth, dense forest, *A. C. Smith 2591*. SURINAM: tree 10 m. high, 12 cm. diam., flowers creamy-tawny, monopetalous, low bush Savanna I, Tafelberg, *24306;* frequent, tree, in low bush 0.5 km. s. w. Savanna I, Tafelberg, *24779*. Amazonian district. New to British Guiana and Surinam.

The Surinam form is one in which the adult leaflets are quite glabrate below. A similar form has been collected in N. Matto Grosse (*Krukoff 1355, 1413,* distributed as *S. recurva* Poepp. et Endl.) and in British Guiana. *A. C. Smith 2993* is a 1-foliate form, perhaps referable to the var. *Snethlageae* (Ducke) Ducke.

SWARTZIA ARBORESCENS (Aubl.) Pittier (102). SURINAM: small tree, pina swamp, vicinity Base Camp on Tafelberg Creek, *24106*. Northern South America. Common throughout Surinam.

PAPILIONACEAE[63]

Page reference is made to the writer's treatment of the family in the Flora of Suriname.[64] One new species, one new variety and two new records are offered in the following account.

DIPLOTROPIS PURPUREA (Rich.) Amsh. (107). BRITISH GUIANA: occasional, tree to 6 m. tall, 6–8 cm. diam., leaves supple, keeled, fruit dry, membranous, greenish-yellow, of bush island, Kaieteur Savanna, *23210*. Guiana, several varieties in N. Brazil.

[63] By G. Jane H. Amshoff.

[64] Flora Suriname 2: 104–257. 1939.

DIPLOTROPIS RACEMOSA (Hoehne) Amsh. var. **kaieteurensis** Amsh., var. nov. Foliolis latioribus subtus glaucescentibus racemis minus densis fructu breviore 5–6 cm. longo, 2.5 cm. lato distinctum.

TYPE: locally frequent, tree 10–12 m. high, 15 cm. diam., leaves finely glaucous below, pods yellow-brown, membranous, seed one, from wallaba forest, Kaieteur Savanna, British Guiana, May 7, 1944, *Maguire & Fanshawe 23294*. New York Botanical Garden.

The species is probably as variable as *D. purpurea* (Rich.) Amsh., also in Brazil. To the variety *kaieteurensis* Amsh. also belongs *Sandwith 1393* (cf. Sandwith in Kew Bulletin 1939 p. 6 sub Bodwichia), from the same region as Maguire's specimen and quite agreeing with it in leaf and inflorescence characters. The dimensions of the fruit in the Brazilian (typical?) specimen *Ducke 24058* are 8 cm. by 2 cm.

ORMOSIA COSTULATA (Miq.) Kleinh. (112). SURINAM: infrequent, shrub to 3 m. high, seed red, Savanna I, Tafelberg, *24222;* frequent, shrub or small tree to 8 m. high, seed bright red, along Lisa Creek, near falls, Tafelberg *24383;* tree, south savanna, vicinity Arawak village of Mata, *24960;* tree to 8 m. high, east side of savanna, Zanderij I, *25051*. Surinam, British Guiana; a variety with sessile leaves also in the Amazonian district. Throughout the country.

SPIROTROPIS LONGIFOLIA (DC.) Baill. SURINAM: frequent, tree 10 m. high, flowers purple, pina-maka lowland, km. 10, vicinity Camp no. 3, Coppenam R. Headwaters, *24854;* frequent, tree to 15 m. high, 20 cm. diam., flowers purple-red, high mixed wallaba forest, km. 24.5, Coppenam R. Headwaters, *24830*. New to Surinam.

An interesting rediscovery of a monotypic genus, hitherto known only from the type collection, made at the end of the 19th century by Leblond in French Guiana. In Maguire's specimens the ovary is 3–4 ovulate instead of 6–8 ovulate; in all other respects it quite agrees with Tulasne's detailed description in Arch. Mus. d'Hist. Nat. Paris IV p. 113–116. The reflexed calyx is one of its most striking characters. Through the courtesy of the Director of the Paris herbarium, I was able to examine the Paris duplicate type, which has served for Tulasne's description.

DALBERGIA GLAUCA (Desv.) Amsh. (118). SURINAM: frequent, shrub to 3 m., flowers lavender, sand bank along railroad bed, Kwakoegron, Saramacca R., *23784;* frequent, 3 m. high, flowers lavender, vicinity Brokolonko, Saramacca R., *23796*. Guiana, Amazonian district. Common throughout the country.

DALBERGIA RIEDELI (Radlk.) Sandw. (122). BRITISH GUIANA: occasional, rope, fruit biconvex-oblong, green-black, woody, riverside, Potaro R. above Kaiatuk, *23356*. Guiana, Amazonian district.

Mr. Sandwith informed me that the fruit described by Bentham for *Hecastophyllum monetaria* Pers. var *Riedeli* Benth. (in Mart. Flora Bras. **15**[1]: 229. 1862) indeed belongs to *Spruce 1546* [K], a duplicate of Radlkofers type specimen. Cf. Ducke in *As Leguminosas de Amazonia Brazileira* (1939), p. 121, where Ducke ascribes fruits of a different type to *D. Riedeli.*

DALBERGIA MONETARIA L. f. (128). SURINAM: frequent, vine, flowers pale pink, along river, low bush bordered by *Montrichardia arborescens* and sparse *Drepanocarpus lunatus,* vicinity Tawa Creek, *23752;* infrequent,

shrub or small tree, bush to rear of village Jacob kondre, *23868;* vine, flowers white, riverbanks above village of Kwatta hede, *23927;* frequent, rope, flowers white, overhanging Tafelberg Creek, *24081;* frequent, rope, flowers white, Tawa Creek, *24079;* liana, 5–10 km. above Boschland, Saramacca R., *24051.* Tropical and subtropical America. A variable species common throughout the country.

MACHAERIUM ACULEATUM Raddi. *M. isadelphum* (E. Mey.) Amsh. (128). SURINAM: infrequent, armed shrub 3 m. high, Charlesburg Rift, sandy soil of old sea beach, consisting of open shrub land, secondary jungle, bordered on both sides by swamps and marshes, 3 km. north of Paramaribo, *22770.* Panama, tropical South America from Venezuela to N. Argentina. In spite of its wide distribution, only twice before collected in Surinam, probably in the same region.

MACHAERIUM QUINATUM (Aubl.) Sandw. (128). BRITISH GUIANA: occasional, 8 cm. diam., scrambler, scandent, fruit greenish with brown pubescence and raised venation, along Potaro R. above Kaiatuk, *23370.* Amazonian district; common throughout Guiana.

MACHAERIUM sp., probably COMPRESSICAULE Ducke. SURINAM: primary forest, vine, vicinity km. 68. Amazonian district. The same species is probably represented by *Pulle 126* and *127*, Sectie O, and by *Pulle 572*, Piaicreek, but flowers and fruit have hitherto not been collected in Surinam. The strongly flattened stem of Maguire's specimen is, however, very suggestive of *M. compressicaule* Ducke.

PTEROCARPUS SANTALINOIDES L'Her. (137). SURINAM: frequent, tree, flowers orange-yellow, lip with purple zone towards center, between Flat Rock Camp and Posoegronoe, Saramacca R., *24921.* Guiana, Amazonian district, Trinidad, St. Vincent, West Tropical Africa. Throughout the country.

DERRIS AMAZONICA Killip (145). SURINAM: frequent, rope, flowers pink, high mixed wallaba forest, vicinity Camp no. 5, km. 17, Coppenam R. Headwaters, *24845.* Amazonian district. Probably throughout the country of Surinam, but not yet known from British or French Guiana.

Andira grandistipula Amsh., sp. nov. Arbor parva ramulis crassis fistulosis lenticellosis glaberrimis. Stipulae magnae, ovatae, obtusae, rigide coriaceae, indistincte nervosae, usque ad 5 cm. longae, 3 cm. latae. Foliola 9, 3 superiora approximata; petioluli crassi ± 1 cm. longi glabri; stipellae ignotae (an desunt?); lamina oblonga obtusa vel acutiuscula base rotundata, coriacea, supra glabra, subtus sparse puberula, 8–12 cm. long, 4.5–5 cm. lata, nervis utrinque latere 8–10, supra obsoletis vel subimpressis, subtus prominentibus. Panicula terminalis folio subaequilonga ± 30 cm. longa glabra; bracteae et bracteolae deciduae, non visae; pedicelli ± 4 mm. longi; calyx margine pubescens ceterumque glabre, ± 6 mm. altus, indistincte dentatus; vexillum ± 15 mm. longum, glabrum; alas et carinalia jam delapsas non vidi; ovarium glabrum.

TYPE: rare, simply branched tree to 3 m. high, 8–10 cm. diam., stipules large, oblong, covering stem below leaves, of bush island, Kaieteur Savanna, British Guiana, May 6, 1944, *Maguire & Fanshawe 23273.* New York Botanical Garden.

Though the material is unfortunately incomplete, the species is a very distinct one by its conspicuous large stipules and glabrous inflorescence.

An allied species is perhaps *A. coriacea* Pulle of Surinam and French Guiana, a large forest tree with much smaller stipules and smaller flowers.

CLITORIA ARBORESCENS Ait. (180). SURINAM: infrequent, tree 5 m. high, 8 cm. dia., high mixed wallaba forest, lateritic soils km. 8, Saramacca R., *24866;* vine, along Saramacca R., between Posoegronoe and Grasi Falls, *24936*. Guiana, Venezuela, Trinidad, St. Vincent, Panama. Not known from the Amazonian district, though common throughout Surinam.

CLITORIA JAVITENSIS (H.B.K.) Benth. var. GLABRA Sagot (182). BRITISH GUIANA: locally frequent, scrambler, stem woody, leaves glaucescent beneath, flowers pale purple, cauliflorous, fruit greenish-brown, Kaieteur Savanna, *23203*. Central America to Colombia, Guiana and N. Brazil. Throughout the colony. Maguire's specimen a form with the leaflets pubescent beneath.

CENTROSEMA BRASILIANUM (L.) Benth. (185). SURINAM: flowers bright purple, grass-sedge savanna, Zanderij II, *25043*. Tropical South America. Common throughout the country.

MUCUNA URENS (L.) DC. (193). SURINAM: rope, flowers greenish, flushed with pink, petal subsucculent, buds purple, vicinity of Camp No. 2, Saramacca R., *24126*. West Indies, Guiana, Brazil, Central America. Probably throughout the country.

CALOPOGONIUM COERULEUM (Benth.) Sauv. (197). SURINAM: vine, flowers blue, overhanging Toekoemoetoe Creek, vicinity Flat Rock Camp, Saramacca R., *24909*. Central America, West Indies, Tropical South America. Probably throughout the country.

DIOCLEA GLABRA Benth. (294). SURINAM: vine, flowers deep purple, Toekoemoetoe Creek, *24070*. Guiana, N. Brazil. Throughout the country.

DIOCLEA MACROCARPA Huber. (205). SURINAM: vine (rope), cauliflorous, flowers purple, high mixed wallaba forest, km. 7, vicinity Camp no. 2, Saramacca R., *24876*. Amazonian district, British Guiana. Rare in Surinam.

DIOCLEA VIRGATA (Rich.) Amsh. (206). SURINAM: infrequent, vine, flowers purple, banner with white bilobed area at base, center deep velvety purple-black, margins purple, bush to rear of Jacob kondre, Saramacca R., *23850*. Northern South America. Throughout Surinam, the most common *Dioclea* species.

DIOCLEA GUIANENSIS Benth. (207). SURINAM: frequent, perennial vine, flowers purple, showy, islands in Brokotoko Rapids, 3 hours above Pakka Pakka, Saramacca R., *23991;* frequent, flowers deep purple, pods brown-pink, rocks, Gran Dam, Saramacca R., *24932*. Northern South America. Common throughout Surinam.

PHASEOLUS CAMPESTRIS Mart. ex Benth. (227). SURINAM: infrequent, vine, flowers pale yellow, riverbank, vicinity Saron Creek, Saramacca R., *23773;* common, vine, flowers yellowish-green, bush to rear of village of Jacob kondre, Saramacca R., *23849*. Brazil, Guiana. Throughout the country.

AESCHYNONEME HYSTRIX Poir. (240). SURINAM: rare, trailing and scandent, Zanderij I, *23731;* flowers pale cream, grass sedge savanna, Zanderij II, *25041*. Central America, Tropical South America. In savannas, probably throughout the country.

STYLODANTHES VISCOSA Sw. (242). SURINAM: to 6 dm. high, flowers

yellow, wet sand, savanna Zanderij I, *23733*. Central America, Tropical South America, West Indies. In savannas throughout the country.

DESMODIUM PROCUMBENS (Mill.) Hitchc. (255). SURINAM: frequent, flowers white, pink-striped, roadside weed, coastal jungle, road to Carl François along Saramacca R., km. 60 from Paramaribo, *23595*. Tropical America. Second collection in Surinam.

LINACEAE

OCHTHOCOSMUS BARRAE Hall. f. BRITISH GUIANA: small tree 3 m. high, flowers white, scrub bush-islands, Kaieteur Savanna, *23469*; tree 4 m. tall, 4–6 cm. diam., flowers white, young fruit green, riverside above Kaieteur Falls, *23348*. Identified by N. Y. Sandwith. British Guiana, Brazil, and Venezuela; possibly more widespread.

RUTACEAE

MONNIERA TRIFOLIA L. SURINAM: weed in and about Kwatta hede, Saramacca River, *23914*; *23948*. Widely distributed in tropical America.

RHABDODENDRON CRASSIPES (Benth.) Hub. sens. lat. BRITISH GUIANA: tree 30 feet high, 6 inches diam., leaves thick, leathery, fruit dark gray, shiny, on a pink fleshy torus, Itumi Road, Mackenzie, Demerara River, *F2497*. British Guiana; Amazonian Brazil.

In his study of Amazonian Rhabdodendron Huber[65] recognized 7 species, 4 new entities (each based on a single Ducke collection), in addition to three previously established, *R. macrophyllum*, *R. crassipes*, and *R. amazonicum*. Ducke[66] subsequently rejected the four proposals of Huber, and further reduced *R. crassipes* to synonomy under *R. amazonicum*, thus leaving the genus (in addition to the unique *R. Gardnerianum*) represented in the Amazon Basin by only two species, the distinct and sharply characterized *R. macrophyllum*, and an exceedingly variable and polymorphic *R. amazonicum*, supporting this interpretation by a discussion of its variability. Recently, Sandwith[67] concurred in this point of view in treating the British Guiana populations broadly as *R. amazonicum* and reduced *Lecostemon sylvestre* Gleason to synonomy under it.

In the study of available material I have inescapably become convinced that we are dealing with a complex of populations, closely related and segregating, that cannot satisfactorily be collected under a single name. I have been forced to interpret the Amazonian material, in question, as falling into at least two species: *R. amazonicum* (Benth.) Hub., with oblanceolate, abruptly acuminate leaves, conspicuously rufus-scurfy paniculate inflorescences, strongly recurved pedicels, and small flowers, the petals 5–6 mm. long, stamens 5–6 mm. long, and style 5–6 mm. long; and *R. crassipes* (Benth.) Hook., with larger, more coriacious broadly elliptic-oblanceolate, abruptly apiculate or short-acuminate leaves, inconspicuously scurfy or glabrous, more or less paniculate inflorescence, strongly recurved pedicels and larger flowers, the petals about 10 mm. long, stamens 10–12 mm. long, and the style 8–9 mm. long. It seems not improbable that *R. crassipes* is the more *polymorphic* and in the Amazon Basin would include the segregates

65 Bol. Mus. Goeldi 5: 424–431. 1909.
66 Arch. Jard. Bot. Rio 3: 181. 1922.
67 Jour. Arnold Arb. 24: 223. 1943.

R. Duckei Hub., *R. paniculatum* Hub., *R. longifolium* Hub., and *R. Arirambae* Hub. (reduced to synonomy under *R. amazonicum* by Ducke (l.c.).

Fanshawe *F2497* fits in best with the *R. crassipes* series, but may represent a segregate distinct from the Amazonian populations.

Rhabdodendron sylvestre (Gleason) Maguire, comb. nov. *Lecostemon sylvestre* Gleason, Bull. Torrey Club. **54**: 609. 1927. BRITISH GUIANA: tree 6 m. high, 8 cm. diam., flowers greenish-yellow, wallaba forest, 89 mile, Martica-Potaro Road, *23558*. Seemingly known only from the Potaro River region, British Guiana.

R. sylvestre apparently is endemic to the Potaro River region, and may be distinguished from *R. crassipes* (*R. amazonicum sens.* Sandwith) by its narrowly lanceolate acute, or acuminate leaves, racemose inflorescence, with ascending, comparatively slender (characteristically in the genus the pedicels of set fruit become greatly thickened) pedicels 1.5–2.5 cm. long. In addition to our collection cited above, I have before me *Gleason 221*, Kangaruma-Potaro Landing, the type of *Lecostemon sylvestre*, and *Sandwith 1237*, between Garraway Stream and Kangaruma.

SIMAROUBACEAE

PICRAMNIA cf. *P. macrostachys* Kl. BRITISH GUIANA: tree 40 feet high, 3 inches diam., leaflets soft, alternate on rachis, flowers in drooping spikes, Keriti Creek, lower Essequibo River, *F1266* (*F.D. 4002*). Guiana.

QUASSIA AMARA L. ex Blom. BRITISH GUIANA: small tree to 15 feet high, inflorescence scarlet, Keriti Creek, Essequibo River, *F869* (*F.D. 3605*), identified by A. Cronquist. SURINAM: small tree to 15 cm. diam., leaves bright green, twigs greenish-red, inflorescence red, flowers bright red, receptacle and fruit red, frequent, Saramacca River bank, vicinity Jacob kondre, *23851*. Bark concoction a Carib fever remedy. Mexico and the West Indies through northern South America; an attractive widely cultivated plant.

Simaba alata Maguire, sp. nov. Arbor mediocris; ramulis obscure angulatis, fuscis, glabris; foliis pari- vel impari-pinnatis, 2–3 jugis, foliolis oblanceolatis, apicibus abrupte acuminatis, basibus acutis, subsessilibus, venis inconspicuis; inflorescentibus paniculatis, amplis, laxis, puberulentibus, compresso-angulatis, pedicellis tenuis; alabastris oblongis; sepalis brevissimis, petalis albidis oblanceolatis, puberulentibus; appendicibus filamentorum pilosis, discis gynophoris breviter albo-pilosis; carpidis sparse strigosis 1–4 maturis, fructibus valde compressis, alatis, nodulo-rugulosis, glabris, obovato-oblongis.

Medium tree, at least to 25 m. high; branchlets obscurely angled, reddish-brown, glabrous; leaves pari- or impari-pinnate, leaflets 4–6, glabrous, oblanceolate 5–12 cm. long, 1.5–3.5 cm. wide, abruptly acuminate at the apex, the base acute, subsessile, venation inconspicuous; inflorescence paniculate, 15–30 cm. long, lax, the axis and branches compressed-angled, puberulent, bracteoles oblanceolate, 2–3 mm. long; sepals 0.5–0.7 mm. long, triangular, densely whitish-puberulent; petals whitish, fleshy, oblong-oblanceolate, acutish, 5–6 mm. long; stamens 10, 4–5 mm. long, filaments subulate, glabrous, appendage oblong, more or less truncate at the summit, 1.25–1.5 mm. long, the free portion nearly 0.5 mm. long, densely long-pilose, anthers orbicular, 0.8 mm. long; gynophore about 1.5 mm. long,

densely white-villous; carpids 3–5, sparsely strigose, the style glabrous, stout, 0.25–0.4 mm. long; drupe 2.0–2.7 cm. long, 1.5–1.8 cm. wide, oblong-obovate, strongly compressed and somewhat convexo-concave, conspicuously winged, the surface strongly nodular-rugulose when dry, purplish at maturity, with a pungent taste somewhat like that of an unripe plum.

TYPE: tree 20 m. high, 1 m. diam., flowers whitish, carpels 2–3–4 at maturity, frequent, Saramacca River bank vicinity Jacob kondre, June 17, 1944, *Maguire 23860*. New York Botanical Garden. Cotype: tree 10 m. high, 20 cm. diam., flowers white, fruit purple, tastes like not quite ripe plum, frequent, Saramacca River bank above Kwatta hede, *Maguire 23940*. New York Botanical Garden.

Simaba alata is without doubt closely allied to *S. crustacea* Engl., which is known only by the type collection *Riedel 1490*, "in silvis prov. do Mato Grosso." This latter species is described as a shrub "2–4 m. altus," with fruit "valde compressus, . . . valde rugosus," and "ferrugineo-puberulo." A photograph of a type specimen at Paris shows the leaflets to be obovate-oblanceolate, the apex broadly rounded or shallowly retuse.

S. alata is a frequent riverside tree along the middle and upper Saramacca, and may well form the basis of Pulle's[68] record of *S. guianensis* from the Upper Saramacca.

SIMABA MONOPHYLLA (Oliv.) Cronquist. BRITISH GUIANA: shrub to 1 m. high with gnarled branches and enamel-black branchlets, leaves stiffly coriaceous, flowers creamy, fragrant, frequent Kaieteur Savanna, *23156; 23156a;* topotypes. Known only from the Kaieteur Plateau.

SIMABA MULTIFLORA Juss. BRITISH GUIANA: tree 110 feet high, 24 inches diam., unbuttressed, fruit oblong, shiny, yellow, fleshy, Groete Creek, Essequibo River, *F1244* (*F.D. 3980*), identified by A. Cronquist.

SIMAROUBA AMARA Aubl. var. TYPICA Cronquist. BRITISH GUIANA: tree 90 feet high, 16 inches diam., unbuttressed, ripe fruit purple-black, fleshy, Mazaruni Station, *F1536* (*F.D. 4272*), identified by A. Cronquist; tree 13 m. high, 30 cm. diam., leaves pale beneath, wallaba forest, Kaieteur Plateau *23345*. Costa Rica, Antigua in the West Indies, to Peru, Bolivia and Brazil, apparently unreported from British Guiana. According to Cronquist[69] the leaflets of *S. amara* mostly vary from 9 to 21. The Kaieteur Plateau tree differed in having but 5–7 leaflets per leaf.

SIMAROUBA AMARA Aubl. var. OPACA Engl. SURINAM: tree 25 m. high, 40 cm. diam., flowers greenish, high mixed forest, south rim, Arrowhead Basin, Tafelberg, *24644*. British Honduras to Brazil according to Cronquist. Apparently hitherto unreported from Surinam.

POLYGALACEAE[70]

The page numbers in parentheses refer to the treatment of the family by A. J. P. Oort in the *Flora of Suriname* **2**: 406–425 (1939).

POLYGALA MOLLIS H.B.K. (409). SURINAM: perennial herb, flowers yellow, sand banks along railroad bed, Kwakoegroen, *23783a*. Venezuela and Guiana. In savannas throughout Surinam.

POLYGALA ADENOPHORA D.C. (412). BRITISH GUIANA: annual herb to

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[68] Enum. Vasc. Pl. Surinam, 244. 1906.

[69] Bull. Torrey Club. 71: 229. 1944.

[70] By G. J. H. Amshoff.

25 cm. high, simple or branched, flowers mauve-pink, capsules dehiscent, green, red-dotted, locally common, in white sand from conglomerate and sandstone, Kaieteur Plateau, *23095*. Venezuela, Guiana, and Northern Brazil.

POLYGALA VARIABILIS H.B.K. (413). SURINAM: flowers purple, frequent, grass savanna, Zanderij II, *23679;* annual flowers whitish, frequent, sand banks along railroad bed, Kwakoegroen, *23782*. Northern Brazil, Guiana, Central America, West Indies. In savannas throughout Surinam, common.

POLYGALA LONGICAULIS H.B.K. (414). SURINAM: annual, rare, sand banks along railroad bed, Kwakoegroen, *23782a*. Tropical and subtropical America. Throughout Surinam.

POLYGALA APPRESSA Benth. (416). BRITISH GUIANA: annual herb to 15 cm. high, flowers pink, fruit green, leaves fleshy, frequent, from moist sand, Kaieteur Plateau, *23112;* Surinam: flowers white, frequent, grass savanna, Zanderij II, *23678;* annual, flowers white, Savanna I, Tafelberg, *24210*. Brazil and Guiana, common throughout Surinam.

BREDEMEYERA DENSIFLORA Benn. var. GLABRA Benn. (417). BRITISH GUIANA: vine from low tree, flowers yellow, with white centers, young fruits flat, obovate, green, rare, in bush island, Kaieteur Plateau, *23275*. British Guiana and Surinam.

SECURIDACA PANICULATA Rich. (419). SURINAM: vine, flowers pink to rose, frequent, 5–10 km. above Boschland, Saramacca River, *24052;* small tree, buds red, overhanging Tafelberg Creek, vicinity of Base Camp, *24902*. Guiana, Peru, Amazonian district. Common throughout Surinam.

SECURIDACA UNIFLORA Oort. (419). BRITISH GUIANA: slender vine from low trees, leaves pale beneath, fruit and samara, brown, wing membranous, locally frequent, in *Terminalia* forest, Kaieteur Plateau, *23310*. British Guiana and Surinam. Known only from the Kaieteur Savanna, and Brownsberg Reserve, Surinam.

SECURIDACA PANICULATA Rich. var. LASIOCARPA Oort. (420). SURINAM: rope climbing to 25 meters, flowers lavender, bush to rear of village Jacob kondre, Saramacca River, *23895*. British Guiana and Surinam.

SECURIDACA DIVERSIFOLIA (L.) Blake (421). SURINAM: vine to 30 m., flowers pink, along railroad near km. 70, *23638*. Tropical South America, West Indies, Panama. Throughout Surinam.

TRIGONIACEAE

Trigonia kaieteurensis Maguire, sp. nov. Frutex scandens; ramulis divaricatis, tenuis, conspicue lenticellatis, foliis oppositis glabris, laminis late ellipticis ad elliptico-ovatis, vel elliptico-obovatis, abrupte acuminatis, chartaceis, apicibus basibusque subconduplicatis, venis prominulis supra, prominentibus subtus; inflorescentibus racemosis, glabris; floribus non visis; capsulis oblongis, acute apiculatis striate rugulosis, lenticellatis, seminibus longo-pilosis.

Scandent woody vine to 2 cm. diam., branchlets divaricate, slender, glabrous, conspicuously lenticellate; leaves opposite, glabrous, (3) 4–7 cm. long, (1.5) 3–4.5 cm. broad, blades broadly elliptic to elliptic-ovate, or elliptic-obovate, the base obtuse, the apex abruptly acuminate, both subconduplicate, veins and midrib prominent on lower surface, prominulous above,

veins 4–5 pairs, ascending; inflorescence simple, racemose, branches 5–10 mm. long, minutely puberulent; capsule oblong, trigonal, terminated by a sharp apiculum about 2 mm. long, strigosely puberulent, 1.5–2.0 cm. long, becoming somewhat wrinkled lengthwise and white-lenticellate; flowers not seen.

TYPE: rope 1–2 cm. diam., scandent on low bush, Kaieteur Savanna, British Guiana, May 3, 1944, *Maguire & Fanshawe 23192*. New York Botanical Garden. *T. kaieteurensis* is most closely related to the lowland *T. microcarpa* Sagot ex Warm., differing in the smaller and relatively broader leaves, the simple inflorescence, and the oblong sharply pointed capsule 1.5–2.0 cm. long, contrasted with the obovate, capsule 7–10 mm. long in the latter species.

TRIGONIA VILLOSA Aubl. SURINAM: liana, stems, under surface of leaves, and inflorescence tawny-villous, mixed wallaba forest, Schmidt Mt., km. 10, Coppenam River Headwaters, *24857*. Specimens seen are from British Guiana, Surinam, and French Guiana. Exceedingly variable, and probably containing several discrete races.

EUPHORBIACEAE[71]

The territory covered by this paper is peculiarly interesting from the standpoint of distribution. Clean-cut ties in the direction of Africa, and the Old World generally, are affirmed by such genera as *Chaetocarpus* and *Maprounea*, and an important region of development of the Euphorbiaceae Codiaeinae Pax & Hoffm. can further be traced to this immediate vicinity. Here is manifestly located a major phytogeographical center of the New World.

Discocarpus mazarunensis Croizat, sp. nov. Arbor 40-pedalis ramulis distichopatulis strictis laxius pilosis; foliis 2–4 cm. latis, 4–10 cm. longis, integerrimis, ellipticis oblanceolatisve apice subabrupte acuminatis, ad basem longius cuneatis, firme chartaceis, in sicco pallide brunneis, nervis primariis obscure anastomosatis ca. 9-jugis, subtus (secus costam) venasque praesertim hispido-pilosis, petiolo ad 1 cm. longo, stipulis late triangularibus; floribus ♂ tantum visis in axillis foliorum primo intuitu optime glomeratis ca. 5 mm. longis, 3–4 mm. latis, sepalis hispidis obovatis, petalis spatulatoerosis, staminibus ad 6–7, in columna 2–3 mm. longa 2-seriatim coalitis, quorum 2–3 pro more inferis, pistillodio gracili, apicali, 2-partito, hispido, glandulis circa columnae basim connatis; caetera desiderantur.

TYPE: Takutu Creek to Puruni River, British Guiana Forest Department, *Fanshawe 2124 (F4860)*. New York Botanical Garden.

I am not satisfied that this species is to remain under *Discocarpus*, for the vegetative characters do not well agree with those of that genus. The ♂ flowers advise this disposition, however, as less objectionable in the light of present knowledge.

PHYLLANTHUS GUYANENSIS Kl. BRITISH GUIANA: This species appears to favor rocky habitats by running waters. Takutu Creek to Puruni River, *F2144 (F.D. 4880)*. British and French Guiana.

DRYPETES VARIABILIS Uitt. BRITISH GUIANA: a large tree to 110 feet tall, easily identified in herbarium by the broad, subentire pileate stylar

[71] By Leon Croizat.

apparatus. Moraballi Creek, Essequibo River, *F1309* (*F.D. 4045*); *F1310* (*F.D. 4046*). Endemic.

HIERONYMA LAXIFLORA (Tul.) Muell.-Arg. SURINAM: tree 25 m. tall, 30 cm. diameter, wood very hard, heart red, flowers white, swampy bush to rear of Kwatta hede, Saramacca River, *23922;* small tree 4 m. high, 5 cm. diameter, flowers greenish-yellow, bush to rear of Jacob kondre, Saramacca River, *23885*. Guyana, Amazon River and Peru.

If indeed euphorbiaceous, a sterile specimen, *F521* (*F.D. 3257*), Makauria Creek, British Guiana, has leaf characters suggesting *H. oblonga* (Tul.) Muell.-Arg.

CROTON TRINITATIS Millsp. *Croton Miquelianus* Lanj. BRITISH GUIANA: locally common annual herb, to 60 cm. high, flowers pale cream, Kangaruma, Potaro River, *23003*. This weed, common in the Caribbeans and northern tropical South America generally, has long passed as *C. chamaedryfolius* Griseb. This binomial rests upon a misapplication of *C. chamaedryfolius* Lam. which is a species of *Acalypha*.

CROTON LOBATUS L. BRITISH GUIANA: banks and swamps, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22933a*. This weed of banks, swamps, and wastes generally occurs throughout tropical America and northern tropical Africa to Arabia, possibly western India.

CROTON GLANDULOSUS L. subsp. **hirtus** (L'Hér.) Croizat, grad. nov. *C. glandulosus* L. f. *hirtus* (L'Hér.) Muell.-Arg., Prodr. **15**(2): 684. 1866; *C. glandulosus* L. var. *hirtus* (L'Hér.) Muell.-Arg., Fl. Bras. **11**(2): 267. 1873; *C. hirtus* L'Her. Stirp. Nov. **17**: *pl. 9*. 1784; Lanjouw, Fl. Suriname **2**: 37. 1932. SURINAM: locally common annual, flowers white, Jacob kondre, Saramacca River, *23803*.

A study of this widespread weed in North America (see Croizat in Jour. Arnold Arb. **26**: 188. 1945) has convinced me that it cannot be treated as a separate species. It easily stands out, on the contrary, as one of the primary forms of the complex to which the binomial *C. glandulosus* is to belong.

CROTON CUNEATUS Kl. SURINAM: frequent, shrub to 3 m. high, reddish sap, gum exuded from central canal, Toekoemoetoe Creek banks, Saramacca River, *24069*. Amazon district, British Guiana, and Surinam. A typically "amazonian" element with discernible affinity toward *C. oblongifolius* Roxb. and its allies, native to India and the Far East.

CROTON HOSTMANNII Miq. BRITISH GUIANA: occasional, shrub with spreading branches, pubescence stellate, flowers white, ♂ upper, ♀ lower, stigmas bilobed to more than ½ length of stigma, bush island, Kaieteur Savanna, *23291*. Endemic. This plant has a rufous cast on innovations and youngest leaves which easily distinguishes it from its allies.

Croton tafelbergicus Croizat, sp. nov. Arbuscula vel frutex ad 12 ped. altus innovationibus parcius stellato-tomentosis glabratisve; foliis 3–7 cm. latis, 10–20 cm. longis ovato-ellipticis, apice acuminato-caudatis, basi rotundato-cuneatis utrinque glandulis pedicellatis praeditis, margine obscure serrato-glandulosis, glabris glabratisve, in sicco pallide olivaceis fragilibus, costa nervisque subtus luteo-brunneis, nervis adscendentibus ca. 7–9-jugis, petiolo herbaceo 3–10 cm. longo; inflorescentia (validiore) ad 12 cm. saltem longa; flore ♂ pedicello gracili 5 mm. longo fulto, staminibus 9–12; flore ♀ pedicello ca. 2 mm. longo, perianthio ca. 5 mm. magno, sepalis triangu-

laribus, late imbricativis, margine denticulato-glandulosis, petalis (videtur) nullis, ovario albicante-hispidulo depresso-globuloso ca. 2 mm. magno, stylis in laciniis stigmaticis 4 subisomeris partitis.

TYPE: small tree to 4 m. tall, ♂ flowers white, perianth ♀ flowers green, opening in medium bush, 1.5 km. south of East Ridge, 920 m. altitude, Tafelberg, Surinam, September 1, 1944, *Maguire 24582*. Arnold Arboretum; New York Botanical Garden. SURINAM: rare shrub to 2 m. tall, Savanna II, Tafelberg, *24402*.

It is suggested from the description that *C. galeopsifolius* Lanj. (Rec. Trav. Bot. Neérl. **31**: 455. 1934) bears at least a superficial resemblance to my new species, from which it is easily distinguished by the size and characters of the ♀ flower. *Croton galeopsifolius* Lanj. may perhaps be represented by *A. C. Smith 3394*, Kanuku Mountains, British Guiana, misdetermined in herbarium as *C. fragilis* L. The affinity involved essentially ranges from the Caribbeans and Central America to Paraguay through eastern Brazil.

Croton nuntians Croizat, sp. nov. Arbor vel frutex, foliis late ovatis trilobisque 8–11 cm. latis, 10–13 cm. longis, in sicco atro-brunneis, pilis stellatis minutissimis dissite conspersis, subtu hinc inde per laminam glandulis lutescentibus baculiformis (oculo armato cautius inquirendis) ornatis, margine subintegris eglandulosis, nervis ca. 5–7-jugis, petiolo herbaceo ad 7 cm. longo, apice glandulosis patelliformibus 2 posticis, 2 anticis (his revera in costa fere impositis) insignito, stipulis glandulosis; inflorescentia valia, pedali vel ultra; floribus ♀ tantum sub fructu tantum; sepalis discretis obovatis ad 3 mm. longis, 2 mm. latis, petalis (videtur) nullis, capsula laevi parcius tomentosa, columella ad 3 mm. longa, semine ellipsoideo 2.0–2.5 mm. lato, ad 4 mm. longo, brunneo, testa verrucis in series parallelibus 3–5 longitudinaliter notata.

TYPE: in *Dicymbe* forest, trail from Tukeit to Kaiatuk, Potaro River Gorge, British Guiana, April 28, 1944, *Maguire & Fanshawe 23054a*. Arnold Arboretum; New York Botanical Garden.

This is an interesting form, to which the indifferent material available might not do full justice. It may prove to be intermediate between two important groups, centering, respectively, around *C. palanostigma* Kl. and *C. gossypiifolius* Vahl. The former is an "Amazonian," the latter a "Caribbean" element, both consisting of numerous more or less sharply differentiated populations. This affinity further ranges to northeastern Mexico (*C. Draco* Schlecht.) and, distantly, Madagascar (*C. platanifolius* Baker). *Croton nuntians* easily differs from *C. palanostigma* Kl. in the 3-lobed leaves, and readily approaches in vegetative characters the forms in the vicinity of *C. gossypiifolius* Vahl. from which it can be separated most easily by the characters of the seed.

CONCEVEIBA GUIANENSIS Aubl. BRITISH GUIANA: occasional, tree 6 m. tall, 4 cm. diameter, fruit green, high mixed forest, Potaro River Gorge, *23523*; Mazaruni Station, Mazaruni River, *F737* (*F.D. 3473*); Moraballi Creek, Essequibo River, *F154* (*F.D. 2763*). Guiana. The foliage of the last-named collections exactly matches a fragment of *Spruce 2826* (type-number of *C. latifolia* Benth.), but the stylar apparatus agrees with standard descriptions of *C. guianensis* (often misspelled: *guyanensis*).

ALCHORNEA TRIPLINERVIA (Spreng.) Muell.-Arg. BRITISH GUIANA: *F2398* (*F.D. 5134*). South Brazil, Bolivia, Amazon River, and British Guiana. The material would seem thoroughly to agree with the form identified by Mueller as *A. triplinervia β meridensis*, represented by an isotype in the herbarium of the Arnold Arboretum of Harvard University.

ALCHORNEA CORDATA (Juss.) Muell.-Arg. *Conceveibum cordatum* Juss. *Aparisthmium cordatum* (Juss.) Baill. BRITISH GUIANA: Bartica-Potaro Road, *F981* (*F.D. 3720*). Surinam: frequent, small slender tree to 5 m. high, 4 cm. diameter, flowers greenish, in sessile glomerules, south base cliffs Arrowhead Basin, high bush, Tafelberg, *21451;* tree overhanging Tafelberg Creek, Saramacca River Headwaters, *24899*. Both specimens are imperfect, but there seems to be no doubt that this is the correct identification. *Alchornea orinocensis* Croiz. may eventually prove to be synonymous of this very variable species.

Angostylis tabulamontana Croizat, sp. nov. Frutex innovationibus puberulis, ramulis adultioribus glabratis; foliis firme chartaceis, pallide olivaceo-concoloribus 1.5–3.0 cm. latis, 6–12 cm. longis, lanceolatis, longe acuminatis, basi cuneatis, margine repando-dentatis, dentibus apice callosis, lamina hinc inde glandulis ceraceis notata, nervis ca. 7-jugis, optime anastomosatis, stipellis nullis, petiolo hispido-pubescenti 0.75–2.0 cm. longo, stipulis caducis; capsula submatura tantum nota fabrica coriacea, pedicello ca. 2 cm. longo fulta, pilis perpaucis obsita, ca. 5 mm. longa, 8 mm. lata, stylis 3 papillosis apice subbicapitatis; caetera desiderantur.

TYPE: shrub in mixed, medium forest, southwest escarpment, Tafelberg, Surinam, September 5, 1944, *Maguire 24636*. Arnold Arboretum; New York Botanical Garden.

The genus is entirely speculative, and considerable risk is incurred by describing seemingly Euphorbiaceae of doubtful or unknown affinity after material which is less than complete. *Angostylis* Benth. is here designated mainly because the lone available capsule points to the affinity of *Tragia* L., and the foliage is at least generally suggestive of Bentham's genus. It might be added that there is no assurance that the generic limits at present accepted in this entire alliance will stand under coming revisions.

PERA GLABRATA (Schott) Baill. BRITISH GUIANA: Mazaruni Station, Mazaruni River, *F647* (*F.D. 3383*). South Brazil, British Guiana, Trinidad. There seems to be little doubt as to the identity of this plant, which is easily identified by its thin-shelled capsules.

PERA SCHOMBURGKIANA (Benth.) Muell.-Arg. BRITISH GUIANA: occasional, tree 4 m. high, 4 cm. diameter, fruit oblong-globose, chocolate-velvety, dehiscent into 3 cocci, seed black, aril scarlet, bush island, Kaieteur Savanna, *23301;* Mazaruni Station, Mazaruni River, *F177* (*F.D. 2913*).

The identification is from description, therefore tentative. Two seemingly different plants are involved in this vicinity, one of which (*23301*) has robust, woody cocci which measure to 17 mm. after dehiscence; the other (*Stahel 82*) much thinner cocci no more than 10 mm. long, and much weaker. The indumentum of the epicarp is in both rufous-tomentose, and the foliage quite similar, so far at least as the herbarium reveals. The small-fruited entity may be *P. bicolor* (Kl.) Muell.-Arg. recorded by Lanjouw, Fl. Suriname **2**: 62(1932), from British Guiana.

SAGOTIA RACEMOSA Baill. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F273* (*F.D. 3009*). British Guiana. The material is ♂ and well agrees with specimens from the Brazilian Amazonas.

Sagotia tafelbergii Croizat, sp. nov. Arbuscula ad 25 ped. alta glaberrima; foliis ellipticis griseo-viridibus subconcoloribus 14–19 cm. longis, 5–7 cm. latis breviter obtuseque acuminatis, ad basem sensim cuneatis, firma chartaceis, subtus saltem perspicue reticulatis, nervis anastomosatis ca. 11–13-jugis, laminae margine integerrimo tenuiter calloso, petiolo ca. 4 cm. longo apice longiuscule inflato-glanduloso, stipulis nullis; inflorescentia ♀ tantum via, tota ca. 4 cm. longa, glabra, e floribus 4, pedicello ad 2 cm. longo interdum prolifero, sepalis ligulatis herbaceis ad 15 mm. longis, 1.5–2.0 mm. latis, apice obtuse acuminatis, petalorum loco (videtur) ligula minima vel glandula laciniata hispida, ovario trigono, late sessili ca. 3 mm. lato, 2 mm. longo, luteo-tomentello, stylis 6, crassis, simplicibus ad basem imam discretis, crure quove integerrimo.

TYPE: small tree to 8 m. tall, flowers white, mixed montane high forest, North Ridge, Tafelberg, Surinam, September 19, 1944, *Maguire 24802*. Arnold Arboretum; New York Botanical Garden.

This plant is certainly very distinct by its styles as against *Sagotia* Baill. and *Sandwithia* Lanj.; only with much better material will it be possible to decide of its true generic position.

Dodecastigma mazarunense Croizat, sp. nov. Arbor ad 20 pedes alta, glabra; foliis 7–17 cm. longis, 3–7 cm. latis ellipticis vel oblanceolatis, apice abrupte acuminatis, basi longe cuneato-rotundatis, hinc inde (basi praesertim) haud obvie ceraceo-glandulosis firme chartaceis, laminae margine more *Garciae* optime calloso, nervis ca. 8–10-jugis petiolo herbaceo sat gracili 1–6 cm. longo, stipulis glandulosis minimis; inflorescentia optime evoluta pedali vel ultra longa adpresse puberula, floribus sat distanter glomerulatis pedicello gracili ad 5 mm. longo; flora ♂ ad 5 mm. magno, sepalis ad basem liberis imbricativis late ovatis, petalis rubescentibus ovato ellipticis obovatisve, staminibus 8–10 toro hispido insidentibus, filamentis gracilibus glaberrimis ad 1.5–2.0 mm. longis; flore ♀ ignoto; capsula trigona laevi puberula pallide brunnea ad 2.5 cm. lata, semine brunneo laevi ellipsoideo 17 mm. longo, 13 mm. lato.

TYPE: in fruit, Takutu Creek to Puruni River, Mazaruni Basin, *Fanshawe 2142* (*F.D. 4878*). New York Botanical Garden. Cotypes: Takutu Creek to Puruni River, Mazaruni Basin, ♂ flowers, *F2028* (*F.D. 4764*); young fruits, *F2142* (*F.D. 4878*).

The foliage of this plant simulates *Garcia nutans* Vahl almost to perfection, but the ♂ flower rules out that genus absolutely. This same flower, and the elongate inflorescence, quite different from that of *Sagotia* Baill. and *Sandwithia* Lanj., point to *Dodecastigma* Ducke. However, Ducke's genus seems to have much shorter hairy stamens in the lone specimen (*Ducke 20716*) which I was able to inspect, but unfortunately proved to be not comparable altogether with the material from Guiana in my hands. The generic designation is tentative, and the systematic position of this very interesting plant will have to be studied anew. It may be that the genus itself is unrecorded.

POGONOPHORA SCHOMBURGKIANA Miers ex Benth. BRITISH GUIANA: Mazaruni Station, Mazaruni River, *F834* (*F.D. 3570*); *F26* (*F.D. 2587*) *CAP*

3 (*F.D. 5256*). Guiana, Amazon River, south Brazil. The foliage is variable, and, as Lanjouw correctly intimates, *P. Schomburgkiana* f. *elliptica* and f. *longifolia* (Pflanzenreich 4(**147**[3]): 109. 1911) are hardly better than transparent vegetative states.

CHAETOCARPUS SCHOMBURGKIANUS (O. Ktze.) Pax & Hoffm. BRITISH GUIANA: Mahdia River, Potaro Basin, *F1009* (*F.D. 3745*). British Guiana. The lignescent crowded processes of the fruit are revealing of the genus, but the glomerulate axillary inflorescence easily suggests at first the Phyllanthoideae.

CUNURIA SPRUCEANA Baill. SURINAM: common, tree to 25 m. tall, 40 cm. diam., rooting at base to 2 m., scant white latex, on drying yellow, leaves chartaceous, flowers white, in high bush, north of Savanna II, Tafelberg, *24279*. *Cunuria* is not reported by Lanjouw, Fl. Suriname **2** (1931–1939). This genus would seem to be improperly placed in the Euphorbiaceae Gelonieae. I should be inclined to think that *Garcia* Vahl, *Sagotia* Baill., *Ostodes* Bl. and *Cunuria* Baill. are not too far distantly related.

OMPHALEA DIANDRA L. BRITISH GUIANA: Groete Creek, Lower Essequibo River, *F1993* (*F.D. 4729*). West Indies, Guiana and Brazil. A full match of the West Indian form. This genus is entirely misplaced in the Euphorbiaceae Gelonieae, for it clearly belongs in the affinity of the Euphorbiaceae Plukenetiinae, as the group is now understood in the classification of Engler & Prantl.

Mabea saramaccensis Croizat, sp. nov. Frutex vel arbuscula ca. 9-pedalis glaber; foliis 3.5–5.0 cm. latis, 14–17 cm. longis, ellipticis, in sicco brunneis, chartaceis, apice abrupte cuspidato-acuminatis, basi latius cuneatis, margine obscure repando-dentatis, nervis 8–11-jugis, bene sat procul a laminae margine anastomosantibus, laqueis amplioribus, petiolo 0.5–1.0 cm. longo, stipulis minutis; inflorescentia sat gracili fere pedali, ochraceo-pulverulenta; floribus ♂ (vix rite cognitis) ad 3 in capitulo quove (ad 1.5 cm. longo, videtur), glandulis binis atris ca. 0.5 mm. ab inflorescentiae axi remotis, staminibus numerosis; floribus ♀ delicatis, pedicello gracili flexuoso ad 1 cm. longo, perianthii lobis imbricativis dorso glanduloso-callosis, longe acuminatis, ovario vix 1.5 mm. magno, stylis gracilibus longe coalitis apice trifidis.

TYPE: frequent, slender shrub 3 m. tall, pedicels and ♂ flowers rose, bracts yellow-green, ♀ flowers rose, inflorescence pendent, pina swamp, Krappa Camp (2), Saramacca River Headwaters, Surinam, July 15, 1944, *Maguire 24123*. Arnold Arboretum; New York Botanical Garden. Topotype: frequent shrub or small tree, single stemmed, to 3 m., Krappa Camp (2), km. 3.5, Saramacca River Headwaters, *24886*.

Mabea is an exceedingly variable genus, but, even making the broadest allowances, it does not prove possible to bring this entity under *M. caudata* Pax & Hoffm. which it resembles at first glance. The foliage has fewer and more obviously ascending primaries; the ovary is smaller and of a different color; the sepals are more markedly acuminate, and the glands under the ♂ capitula anything but sessile, as they often are in *M. caudata*.

MABEA CAUDATA Pax & Hoffm. BRITISH GUIANA: Mahdia Creek, Potaro River, *F749* (*F.D. 3485*). SURINAM: common, slender bush, vicinity Savanna III, Tafelberg, *24260*; slender tree 5 m. tall, 4 cm. diam., low bush, 1 km. south of Savanna I, Tafelberg, *24353*. British Guiana, Surinam. The

first two specimens cited well agree with the descriptions; the last might, perhaps, belong to Lanjouw's var. *concolor*.

MABEA PIRIRI Aubl. BRITISH GUIANA: Siba Creek, *F683* (*F.D. 3419*); Mazaruni Station, Mazaruni River, *F704* (*F.D. 3440*). Guiana. The collections are an excellent match of *Hostman 1320*.

MABEA TAQUARI Aubl. SURINAM: infrequent, small tree or shrub, petals minute, pink, styles 3, glands black, below rapids, Jacob kondre, Saramacca River, *23841*. Trinidad, Venezuela, and Guiana. This collection very closely agrees with the material under this binomial in Lamarck's herbarium, now at the Paris Museum.

MABEA SCHOMBURGKII Benth. BRITISH GUIANA: Mazaruni Station, Mazaruni River, *CAP 2* (*F.D. 5255*); Canje River, *60 G* (*F.D. 668*).

Mueller Argoviensis is probably correct in stating, "Summopere affinis *M. Taquari*, a qua non nisi capsulis armatis rite distinqui potest." The material is scanty, but that *M. Tarquari* and *M. Schomburgkii* are most close seems clear. The latter is occasionally quite glabrous, even strikingly so (e.g. in the first of the specimens above cited), but other collections (which indeed seem to belong to this species) indicate that the young growth is, or may be, pubescent (e.g. *Williams 11343:* Medio Caura, Bolivar). This plant is a small shrub, dwelling in sandy habitats by watercourses, and often clambering on surrounding vegetation. It seems probable that processes on the capsule further occur in *M. nitida* Benth. (*Spruce 3116* in herb. Arnold Arb.), but this species has different foliage, sometimes reminiscent of a willow (e.g. *Williams 16189:* Middle Ventauri, Upper Orinoco; *Williams 15599:* Capihuara; *Williams 15463:* Esmeraldas, Upper Orinoco). *Mabea* is badly in need of a searching study, but very abundant material showing all different stages of foliage, anthesis and fruitification, is needed for successful work in herbarium. It remains to be seen whether *M. Taquari* Aubl. and *M. Schomburgkii* can truly be extricated as different species.

MABEA ARGUTISSIMA Croiz. BRITISH GUIANA: Bartica-Potaro Road, *F1442* (*F.D. 4178*). As I have pointed out in a previous occasion (Caldasia 2[9]: 362. 1944), only a study of *Glaziou 10035*, type of *M. subsessilis* Pax & Hoffm. is to decide whether *M. argutissima* is to fall in the synonymy of that species. The type locality of *M. subsessilis* is southern Brazil, and Index Kewensis places it in the state of Espirito Santo. The flora of the Amazonian basin and eastern Brazil have much in common, but are not necessarily identical, which induced me to retain my binomial pending a critical study of the type.

SEBASTIANIA CORNICULATA (Vahl) Muell.-Arg. *Tragia corniculata* Vahl. SURINAM: frequent annual, primary jungle, Charlesburg Rift, 3 km. north Paramaribo, *22758;* km. 68, vicinity Sectie O, *24999*. West Indies, Colombia, French Guiana, Surinam, and south Brazil.

The type locality is Trinidad, and *Broadway* s.n., Trinidad, Icacos "near the sea," ought accordingly to match Vahl's figure. I find it does not, however, for the *Broadway* specimen has three tiers of processes on the capsule whilst the figure in question shows only two. Moreover, the foliage of the Broadway material tends to be somewhat narrower (i.e. more linear) on the whole than that of Vahl's original figure. On the whole, this figure better agrees with *Hoehne 25059:* Morro de São João, Rio de Janeiro;

which merely indicates, in my opinion, the presence of the typic form and variants in its immediate vicinity, along the entire American shoreline from Rio de Janeiro to the West Indies. This species is a characteristic coastal element which in geologic epochs past followed the marine shore in epochs of transgression and regression, and presently occurs with countless forms over a wide range. Its development parallels acordingly that of the group in the immediate vicinity of the littoraneous *Croton punctatus* Jacq., to which may be credited in derivation *C. californicus* Muell.-Arg., *C. gracilis* H.B.K., *C. neo-mexicanus* Muell.-Arg., etc. Unlike *Croton*, however, *Sebastiania* has failed to speciate so far enough as to yield clean-cut taxonomic entities worthy, in my opinion, of the name of species by a broad consideration of the entire affinity. I am not inclined for this reason to dismember *S. corniculata* Vahl into a number of truly separate entities. *Maguire & Stahle 22758* is an excellent match of the cited *Broadway* collection, but *Maguire & Stahel 24999* may answer a form which seems to be intermediate between *S. micrantha* (Benth.) Lanj. and *S. linearifolia* Lanj.

MAPROUNEA GUIANENSIS Aubl. BRITISH GUIANA: frequent, 3 m. tree, 3 cm. diameter, ♂ flowers oblong, yellow, bush island, Kaieteur Savanna, *23438;* Moraballi Creek, Essequibo River, *F594* (*F.D. 3330*); Bartica Potaro Road, *F1474* (*F.D. 4210*). Tropical South America, from Guiana to Rio de Janeiro. The ticket of the first number here cited speaks of a "3 m. tree," while that of the second refers to a "90′ tree, 24″ diam. from light brown loose sand at edge of kautaballi and wallaba forest."

EUPHORBIA MORISONIANA Kl. ex Seem. SURINAM: vicinity of Agricultural Experiment Station, Paramaribo, *22715.* This species was mistakenly reduced by Boissier (in DC. Prodr. 15 (2): 73. 1862) to the status of a synonym of *E. barbellata* Engel., while its publication clearly antedates the latter's by at at least six years.

This plant may be succinctly characterized as a form of *E. prunifolia* Jacq., having, unlike the type (Hort. Schoenbr. Ic. Pl. **3**: 15, *pl. 277*), in part at least, pandurate-dentate leaves and bracts checked with white or yellow. I am not sure that it is identically the same as *E. barbellata* Engelm., the type locality of which is on the Rio Grande "near Eagle Pass," but I have frequently seen it from Central America (*Woodson, Allen & Seibert 1216, 1368:* Panamá; *Allen 561:* Costa Rica; *Steyermark 37681:* Guatemala) and southern Mexico (*Matuda 4731:* Chiapas), though in nearly every case misidentified as *E. heterophylla* L. In central and eastern Mexico forms appear, wholly typical of *E. prunifolia* Jacq. (e.g. *Bourgeau 1692* "Vallée de Cordova") or transitional to *E. heterophylla* L. and its minor segregates (e.g. *Bourgeau 2662* "Région d'Orizaba, Rio Blanco"). To forms of the kind may indeed belong the Peruvian *E. elliptica* Lamck. which is indicated as the earliest binomial (Encycl. **2**: 425. 1788) pertaining to affinity immediately in this group. It may be noticed that Lamarck's *E. elliptica* long antedates Thunberg's (Prodr. Pl. Cap. 86. 1800; Rothmaler, Chron. Bot. **5**: 440. 1939). I venture to predict that it may not be easy to extricate *E. prunifolia* Jacq. from *E. heterophylla* L. in the course of a searching study of this proteiform affinity.

CHAMAESYCE GLOMERIFERA Millsp. *Euphorbia glomerifera* (Millsp.) Wheel. SURINAM: vicinity Agricultural Experiment Station, Paramaribo, *22764.* I accept this binomial as a matter of convenience, for it has been

widely used of late in herbarium. I am skeptical of its ultimate value, nevertheless, because I fail to see how this form can be extricated as a separate species out of the Old World *C. pilulifera* (L.) Small, *C. hypericifolia* (L.) Millsp., and *C. indica* (Lamck.) Croiz. This group is badly in need of critical revision on a world-wide scale, as local studies merely add to confusion and ultimate synonymy.

CHAMAESYCE HIRTA (L.) Millsp. *Eurphorbia hirta* L. *Euphorbia pilulifera* L. SURINAM: vicinity Agricultural Experiment Station, Paramaribo, *22763*. This very common weed has oftentimes passed as *C. pilulifera* auct. or *E. pilulifera* auct., but has nothing to do with that species, which belongs to a different affinity centering around *C. hypericifolia* (L.) Millsp.

HEVEA cf. *H. guianensis* Aubl. BRITISH GUIANA: Bartica-Potaro Road, *F750* (*F.D. 3468*); Waiapi Creek, Lower Mazaruni River, *F1417* (*F.D. 4153*).

ANACARDIACEAE

ANACARDIUM OCCIDENTATE L. SURINAM: Charlesburg Rift, Paramaribo, *22743*. Widely cultivated in tropical America.

THYRSODIUM DASYTRICHUM Sandw. BRITISH GUIANA: tree 40 feet high, 6 inches diam., leaflets softly pubescent, flowers in very large velvety-tomentose, dark purple-brown terminal panicles, Mazaruni Station, Mazaruni River, *F1713* (*F.D. 4449*) British Guiana.

The Fanshawe specimen is quite similar to the type of *T. dasytrichum*, *Locke in Forest Dept. no. 2019*, Cuyuni River, B. G. in leaf form and pubescence, and in the dense dark red-brown tomentum of the inflorescence; the flowers of the staminate inflorescence *F1713*, are about 6 mm. long, those of type pistillate *F.D. 2019* are 7 mm. long. The species is said to differ from *T. Schomburgkianum* in its foliar pubescence and larger flowers.

Since *T. dasytrichum* was proposed[72] a more extended series of *Thyrsodium* all designated as *T. Schomburgkianum* has come to hand, *Smith 3185* and *3609* from British Guiana, *Lasser 1378* from Venezuela, *Killip and Smith 30504* from Pará, *Krukoff 1143* from Pará, and *Froes 1941* and *2025* from Maranhaõ. These in addition to the isotype of *T. Schomburgkianum, Schomburgk 892,* and *Spruce 1749* from the Rio Negro, present series in which the pubescence distinction is essentially broken down, and flowers vary from 5 to 7 m. in length.

Smith 3609 from the Kanuku Mountains has the essentially glabrous, veiny leaflets of *T. Schomburgkianum* but dark heavy inflorescence pubescence of *T. dasytrichum, Smith 3185* likewise from the Kanuku Mountains has the leaflet glabrosity and inflorescence pubescence of *T. Schomburgkianum.* And *Krukoff 1143* from Pará, has the pale thin inflorescence pubescence of the last but the leaflet pubescence of *T. dasytrichum.*

It thus seems here may be a single variable but continuous species with the population of coastal Guiana having the indument of the inflorescence densely tomentose and strongly pigmented, and the leaflet underside usually villous, while that of the interior Hylea and Amazon Basin has the converse, i.e., essentially glabrous (but sometimes villous) leaflets, and pale, thinly tomentose inflorescences. Possibly two subspecific races may be represented, for certainly typical material of each is strikingly distinct.

[72] Kew Bull. 1932: 210.

TIPARVIA GUIANENSIS Aubl. BRITISH GUIANA: Bartica-Potaro Road, *F1492* (*F.D. 4228*). SURINAM: tree 15 m. high, 20 cm. diam., Arrowhead Basin, Tafelberg, *24603; Tafelberg, 24631;* Sanderij I, *24953*. Widely distributed in tropical America.

CYRILLACEAE

CYRILLA RACEMIFLORA L. BRITISH GUIANA: shrub to 2 m. high, leaves somewhat secund, red-margined, flowers white, young fruit greenish, galled fruits red, frequent, Kaieteur Savanna, *23106;* tree 40 feet high, 8 inches diam., edge of savanna on white sand, Ituni Road, Mackenzie, Demerara River, *F2506* (*F.D. 5242*). Widespread, Virginia to Texas, U.S.A., Central America, West Indies, Venezuela, British Guiana, northern Brazil.

HIPPOCRATEACEAE[73]

HIPPOCRATEA VOLUBILIS L. BRITISH GUIANA: Baramanni Creek, Waina River, N. W. D., *F2332;* Koburaima Creek, Aruka River, N. W. D., *F2401*. SURINAM: Saramacca River, *23764, 23824, 24050, 24053*. Widespread in tropical America.

PRIONOSTEMMA ASPERA (Lam.) Miers. BRITISH GUIANA: rare bush-rope, with red sap, in tops of tall trees in mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22915*. Widespread in tropical America.

CUERVEA KAPPLERIANA (Miq.) A. C. Sm. BRITISH GUIANA: medium hard gray rope 3 cm. diam., from crown of a *Terminalia* by river, leaves stiff, leathery, calyx yellow-green, petals white, flowers sweet-scented, Groete Creek, Essequibo River, *F1731;* 10 cm. diam., dark brown medium hard rope from crown of a *Mora,* leaves thickly chartaceous, capsules biconvex, obovate, woody, glaucous-green with shallow crimson cracks, bilobed, dehiscent at maturity, nuts 4–6 per capsule, chestnut-brown, the testa irregularly winged, kernels edible, vernacular name *Karoshiri,* Groete Creek, Essequibo River, *F1994*. Widespread but not locally abundant in tropical America.

HYLENAEA COMOSA (Sw.) Miers. BRITISH GUIANA: red-brown soft rope from crown of a *Mora,* 20 cm. diam., pedicels delicate, creamy, flowers creamy, Groete Creek, Essequibo River, *F1745,* Eastern Venezuela, Guiana, and Trinidad, probably erroneously recorded from "Hispaniola." The cited specimen is only the third from British Guiana known to me.

SALACIA AMPLECTENS A. C. Sm. SURINAM: bush-rope with green flowers, in high mixed forest, Tafelberg *24717*. Previously known only from the type, collected along the Macouria River, British Guiana. A second collection of this remarkably distinct species, which is without close relatives, is very welcome; the floral characters are precisely similar to those of the type.

SALACIA MULTIFLORA (Lam.) DC. SURINAM: rope, with yellowish green flowers, on lower branch of tree overhanging Grace Creek, Tafelberg *24558*. Although this is the first Surinam specimen of the species which has come to my attention, it is known from ample material from French and British Guiana and Amazonian Brazil.

SALACIA KANUKUENSIS A. C. Sm. SURINAM: bush-rope, on diabasic soil in mixed high forest, flowers tan, cauliflorous [and also axillary], Tafel-

[73] By A. C. Smith.

berg *24722*. Previously known only the type-collection, Kanuku Mts., British Guiana. Although the Surinam specimen is slightly more robust (with petioles up to 16 mm. long and leaf-blades up to 16 × 6.5 cm.) than the type, it agrees well in all essential details.

SALACIA aff. *juruana* Loes. BRITISH GUIANA: pliant rope growing in crown of a *Licania venosa*, petals green-yellow flushed with brown at base, disk green, Motocooro Creek, *F305*. The cited specimen, although obviously a member of my species-group *Ellipticae* (Brittonia **3**: 426. 1940), can be referred to a species only tentatively on the basis of available material; it also suggests *S. impressifolia* (Miers) A. C. Sm. Neither of the two species here mentioned has previously been recorded from the Guianas.

TONTELEA RICHARDI (Peyr.) A. C. Sm. BRITISH GUIANA: soft greyish rope 5 cm. diam. from crown of a *Pouteria* in mixed forest on loam, flowers yellow to red, Black Creek, Groete Creek, Essequibo River, *F1791*. A rare species, known from British and French Guiana and probably also occurring in Panama, this is the third collection known to me from British Guiana.

PERITASSA GRANULATA (Urban) A. C. Sm. BRITISH GUIANA: gray rope 1 cm. diam., growing on *Pera glabrata* by river-bank, leaves leathery, stiff, fruit axillary, green when young, yellowish when ripe, subglobose [apparently up to 5 cm. diam.], thinly fleshy, seeds 5 or 6, segment-shaped with thin pulpy covering, the testa reddish, Mazaruni Station, *F2517*. SURINAM: rope, climbing to forest top, in mixed high wallaba forest, km. 7, Saramacca River, *24872*. New to British Guiana. Fruiting material of this comparatively rare species has not previously been seen by me, but the cited specimens agree well with those cited in Brittonia **3**: 513 (1940). Otherwise known from Tobago and Surinam.

CHEILOCLINIUM COGNATUM (Miers) A. C. Sm. BRITISH GUIANA: tree 15 ft. high and 2 inches diam., in mixed forest on lateritic soil, leaves leathery, pale beneath, vernacular name *Monkey Syrup*, Takutu Creek to Puruni River, Mazaruni River, *F2082;* undergrowth tree 30–40 ft. high and 4 in. diam., in greenheart bush on brown sandy loam; calyx yellow-green, petals orange-brown with purple margins, Mazaruni Station, *F102*. Widespread in tropical America.

CHEILOCLINIUM HIPPOCRATEOIDES (Peyr.) A. C. Sm. BRITISH GUIANA: occasional bush-rope 3 cm. diam., fruit ovoid, yellow, many-seeded, Potaro River below Tukeit, *23495;* grey-stemmed rope 2 in. diam., flowers yellow, Mahdia R., Potaro R., Bartica-Potaro Road, *F1026*. Guiana to Amazonian Peru, Bolivia, and Brazil, known from only one other British Guiana collection, from the Bartica-Potaro Road.

CHEILOCLINIUM cf. *C. anomalum* Miers. BRITISH GUIANA: grey soft rope 5 cm. diam. from crown of an *Eschweilera* in mixed forest on loam, fruit [not available with specimen] orange, subglobose, irregularly angular, thinly fleshy, with 4–8 seeds embedded in yellowish mucilage, these ovoid, flattened on one or two sides, dark brown, faintly striated on rounded side, Black Creek, Groete Creek, Essequibo River, *F1787*. As the available specimen is sterile, I hesitate to refer it with certainty to *C. anomalum*, however, it bears a very close resemblance in foliage to the only previously recorded specimen of the species from British Guiana (cited in Brittonia **3**: 549. 1940).

ICACINACEAE[74]

DISCOPHORA GUIANENSIS Miers. BRITISH GUIANA: tree 10 m. high, 10 cm. diam., mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22952*. Widespread, Colombia and British Guiana to Peru and Amazonian Brazil.

EMMOTUM ARGENTEUM Gleason. BRITISH GUIANA: tree 6 m. tall, 6–8 cm. diam., buds mealy green, flowers white, from bush island, Kaieteur Savanna, *23339*.

First collection since the type collection of Tate from Mt. Duida. Ovary in the present specimens is also 2-celled. Original description must have been in error calling for a 3-celled ovary.

SAPINDACEAE

CUPANIA HIRSUTA Radlk. *C. lanuginosa* Sagot ex Radlk. SURINAM: slender tree 5 m. high, 5 cm. diam., flowers white, pubescence light brown, mixed "dakama" high forest, 5 km. northeast Savanna II, Tafelberg *24708*. Venezuela, British Guiana, Surinam, and French Guiana. Our specimen is longer and somewhat more softly hirsute than is characteristic of most collections.

Radlkofer[75] has distinguished two species of the closest affinity, essentially by the presence of glands on the lower leaf surface of *C. hirsuta* and the absence of glands on the leaves of *C. lanuginosa*. Careful examination, with suitable magnification, of a larger series of well collected specimens (including *Rusby & Squires 176*, cited by Radlkofer) fail to show the presence of glands. Not infrequently small irregularly disposed lesions of a pathologic nature are present. These may have been interpreted by Radlkofer as glands. The leaves of *Melinon*, in 1863, from French Guiana, cited by Radlkofer (op. cit.) as *C. lanuginosa* show such lesions. It would seem then that the specimens hitherto included under the two names are conspecific, and that *C. lanuginosa* Sagot ex Radlk. must be placed in synonomy under *C. hirsuta* Radlk.

MATAYBA ARBORESCENS (Aubl.) Radlk. SURINAM: slender tree 8 m. high, 8 cm. diam., fruit 3-winged, mixed high wallaba forest, km. 19, headwaters Coppenam River, *24838*. Widely distributed. Trinidad, Guiana, Brazil.

TALISIA ELEPHANTIPES Sandw. SURINAM: tree 12 m. high, 12 cm. diam., leaves to 1.5 m. long, inflorescence to 5 dm. long, flowers white, frequent, mixed high montane forest, North Ridge, Tafelberg, *24797*. Described recently from British Guiana[76] from a specimen collected on the Cuyuni River drainage. Now collected in Surinam. Our specimens quite certainly are properly referred here although the disc is scantily hirsute, not glabrous as is said for the British Guiana plant.

TALISIA HEMIDASYA Radlk. SURINAM: small tree or shrub, flowers white, high forest, base north escarpment, Tafelberg, *24340; 24341; 24690*. British Guiana and Surinam.

TOULICIA cf. *T. elliptica* Radlk. SURINAM: tree 15 m. high, 18 cm. diam.,

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[74] By R. A. Howard.
[75] Pflanzenreich 4^{165}: 1052–1053. 1933.
[76] Jour. Bot. 78: 256. 1940.

leaves to 1.5 m. long, rachis slender, segments more or less remote, leaflets 16–20, more or less elliptic, inequilateral, abruptly acuminate, when well developed 15–30 cm. long, 6–10 cm. broad, entire, thinly chartaceous, glabrous, petiolules 1–2 cm. long, petioles, coarse, rough, glabrate; inflorescence paniculate, ample, to 50 cm. long, thinly brownish tomentulose; pods 3-celled inflated papery, puberulent, 3.0–3.5 cm. long, flowers unavailable, but disc apparently villous, high mixed wallaba forest, km. 7, Sacramacca River headwaters, *24875*.

T. elliptica, as reported by Radlkofer,[77] evidently has been known from the incomplete collection of *Spruce 2290*, of São Gabriel, Amazonas. Our collection apparently is not conspecific with any of the three species, *T. guianensis*, *T. pulvinata*, and *T. patentinervis* admitted into the flora of Surinam by Uittien.[78] I strongly suspect that our collection represents yet another species, but for lack of comparative material, must associate it with *T. elliptica*.

PAULLINIA cf. *P. stellata* Radlk. SURINAM: liana, lateral inflorescences long-pedunculate, terminal short-pedunculate, or subsessile, fruit orange red, secondary bush along railway, km. 70, Sectie O, *23613*. Our collection seems to bridge the distinction between *P. stellata* known only by the type *Mélinon n. 47* from French Guiana, and *P. parvibractea* known only by the type *Martius* from Amazonas. It is suggested that these two type specimens, and our *23613* from Surinam may be conspecific.

TERNSTROEMIACEAE[79]

With the exception of the first two species, all the members of this family listed below have been treated in my recent paper on the South American species of *Ternstroemia* (Jour. Arnold Arb. **23**: 298–343. 1942) wherein synonymy, description of species, and citation of specimens are furnished in detail. A parenthetical page reference to the above paper is listed after the specific authorship.

BONNETIA SESSILIS Benth. BRITISH GUIANA: occasional, tree about 4 m. in height, 6 cm. in diam., leaves coriaceous, verticillate, crowded at the apex, convex, suffused in part with red, buds crimson, petals white, delicate, concave, spreading, Kaieteur Savanna, *23258*. Formerly known only from Mt. Roraima.

The petals are more often edged with pink or pale rose. The submarginal vein is an excellent distinguishing feature of this species.

ARCHYTAEA MULTIFLORA Benth. BRITISH GUIANA: rare, small tree to 4 m. in height, 10 cm. in diam, leaves coriaceous, brittle, crowded at the apex of the branchlets, red-margined, the very young leaves white on the upper surface, buds convolute, flowers rose-pink, stamens same, peduncles gray, bracts waxen gray, in white sand from conglomerate and sandstone, Kaieteur Savanna, *23108*.

Known also from Mt. Roraima and Mt. Duida in Venezuela.

TERNSTROEMIA CIRCUMSCISSILIS Kobuski (304). BRITISH GUIANA: tree 18 m. in height, 10 cm. in diam., leaves glabrous, coriaceous without visible

[77] Pflanzenreich 6^{165}: 622. 1932.
[78] Flora Suriname **2**: 369–371. 1937.
[79] By C. E. Kobuski.

veins, flowers axillary 1–2, peduncles curved, fruit broadly ovoid, tapering into a persistent style, 2- or 3-celled, pale yellow, dehiscence circumscissile at maturity near the base, leaving seeds attached to placentae, seeds 4–6, pale cream, somewhat angled or kidney-shaped, covered by a soft red oily aril which is rubbed off easily, *Clusia* pole forest, 12 miles up the Kaituma River, *F2408* (F.D. 5144). Recorded for first time from British Guiana. Formerly known only from the Mapiri Region, Bolivia.

The circumscissile dehiscence at the extreme base of the fruit is the outstanding character of this species, unusual in a genus in which the fruit is considered indehiscent, or if dehiscent not conforming to a formal pattern.

TERNSTROEMIA PUNCTATA (Aublet) Swartz (307). BRITISH GUIANA: frequent, shrub 1.5–4 m. in height, corolla-lobes yellowish in color, fruit yellow-green, from bush island, Kaieteur Savanna, *23271*. SURINAM: Sanderij, Savanna No. II, *23695;* Tafelberg, Savanna No. I, *24257*. Known also from Venezuela and Brazil.

Further distinguishing characters are the entire leaves, tan or reddish brown in color with punctate dots on the lower surface, the veins generally evident on the upper surface only, the long acuminate corolla- and calyx-lobes, the latter thick and star-like when expanded in the fruiting stage, the caducous bracteoles leaving triangular scars, and the three-parted style and three-celled ovary and fruit.

TERNSTROEMIA BROWNIANA Kobuski (309). BRITISH GUIANA: tree 10 m. in height, 20 cm. in diam., copiously branched, leaves thin-coriaceous, adpressed to the stem, flowers axillary, solitary, cream colored without, pink-red within, edge of dakama scrub, Ituni Road, Mackenzie, Demerara River, *F2477* (*F.D. 5213*). Known only from British Guiana.

The ovary is three-celled with a single ovule in each cell, all three ovules developing in the fruit. The style is entire and the stigma is punctiform.

TERNSTROEMIA CANDOLLEANA Wawra (311). SURINAM: frequent, open low bush, shrub up to 4 m. in height, or small tree, leaves coriaceous, buds pink, Savanna IV, Tafelberg *24408;* extensive rock and pygmy bush openings, Savanna VIII, Tafelberg *24445*. Known also from Brazil.

TERNSTROEMIA SCHOMBURGKIANA Benth. (313). BRITISH GUIANA: occasional, tree up to 5 m. in height, 8 cm. in diam., leaves coriaceous, obovate, 6–7 cm. long, up to 3 cm. wide, obtuse or rounded at the apex, entire or inconspicuously serrulate, punctate-dotted on lower surface, flowers aggregate at the tips of the branchlets, corolla-lobes acute, equalling the calyx-lobes in length, fruit broadly ovoid, tapering abruptly at the apex into the persistent style, Kaieteur Savanna, *23239*. Known only from British Guiana.

Although listed by the collector as "occasional," this species is generally considered quite rare, the known collections very few in number.

TERNSTROEMIA DENTATA (Aublet) Swartz (330). SURINAM: small slender tree to 4 m. in height, 5 cm. in diam., calyx-lobes pink within, corolla-lobes yellow, overhanging cliffs, west escarpment, Tafelberg *24685*. Known also from French Guiana and Brazil.

This specimen varies from typical *T. dentata* in its larger leaves (up to 20 cm. long), sharply acuminate at the apex. However, like typical *T. dentata,* the leaves are distinctly dentate (a most unusual feature in this

genus), the stamens two-seriate with the apicules nearly 2 mm. long, the ovary two-celled and four-ovulate, and the stigma punctiform.

TERNSTROEMIA VERTICILLATA Klotzsch ex Wawra (333). SURINAM: tree up to 15 m. in height, 20 cm. in diam., calyx-lobes pink, white bordered, corolla white with yellowish lobes, north of Savanna II, Tafelberg *24278;* margin of Arrowhead Basin, Tafelberg *24417.* Known also from British Guiana.

The outstanding characters of this species are the verticillate branchlets and leaves, the leaves truncate or retuse at the apex, submembranaceous, the pink calyx-lobes which are glandular-denticulate, the corolla-lobes coalesced for over two-thirds the entire length, and the uniseriate stamens.

FLACOURTIACEAE

BANARA GUIANENSIS Aubl. SURINAM: tree to 8 m. high, locally infrequent, Charlesburg Rift, 3 km. north of Paramaribo, *22781.* Central America, Venezuela and Trinidad to Brazil and Peru.

CARPOTROCHE SURINAMENSIS Uitt. BRITISH GUIANA: shrub 8 feet high, flowers white, buds orange, from mixed forest on brown sand, Madray Landing, Essequibo River, *F1703* (*F.D. 4439*). SURINAM: small tree, infrequent along banks of Saramacca River, vic. Jacob kondre, *23859.* British Guiana and Surinam.

CASEARIA GUIANENSIS (Aubl.) Urb. BRITISH GUIANA: small tree, from savanna edge, Orealla Creek, Courantyne River, *F2592* (*F.D. 5380*). SURINAM: small tree, frequent in second growth bush to the rear of Jacob kondre, Saramacca River, *23853a; 23587a.* Widely distributed in tropical America.

CASEARIA MACROPHYLLA Vahl. BRITISH GUIANA: tree 30 feet high, 4 inches diam., mixed forest, Moraballi Creek, Essequibo River *C.A.P. 19* (*F.D. 5328*). SURINAM: small tree, flowers white, mixed high forest, base north escarpment, Tafelberg, *24301.*

CASEARIA SILVESTRIS Sw. SURINAM: tree to 12 m. high, 15 cm. diam., fruit shining reddish, swampy bush above village along Saramacca trail, Jacob kondre, *23878.*

EUCERAEA NITIDA Mart. BRITISH GUIANA: tree 25 feet high, Kurupung River, *Pinkus 243.* Surinam: shrub to 4 m. high, flowers white, soon falling, frequent, Savanna I, Tafelberg, *24396a.* Venezuela, British Guiana, Surinam, and Amazonian Brazil. Hitherto unrecorded for Surinam.

HOMALIUM DENSIFLORUM Spruce ex Benth. BRITISH GUIANA: tree 20 ft. high, 3 inches diam., flowers whitish, very sweetly scented, Essequibo River by Yokaramare Creek, *F1353* (*F.D. 4086*)*;* tree 40 feet high, 7 inches diam., riverside, Mazaruni Station, *C.A.P. 8* (*F.D. 5261*). British Guiana, Brazil, probably also Venezuela and Peru.

In British Guiana there seems to be some little correlation in the smaller flowers, more densely pilose ovary, more pronounced obconic hypanthum, and tendency toward the racemose condition among British Guiana specimens; this is in contradistinction to the larger, less densely pilose, essentially sessile flowered forms which go under the name of *H. guianensis.* To *H. densiflorum,* so interpreted, should also be assigned the following: Demerara River, *Jenman 3894;* Demerara, *Jenman 4882;* and Moruka River, *la Cruz 4594.*

At best this is a weak, possibly unnatural assemblage inadequately distinct from *H. guianensis* with larger, sessile flowers on the one hand, and *H. pedicellatum* (*Persand 54* would belong here) with larger, pedicellate flowers on the other. I strongly suspect that the plants, as delimited by Blake,[80] under the three names here considered, actually belong to a single polymorphic species.

HOMALIUM GUIANENSE (Aubl.) Warb. sensu stricto. SURINAM: tree 15 m. high, 20 cm. diam., flowers greenish-white, frequent along river, vic. Brokolonka, *23795;* bushy tree 4 m. high, flowers greenish, fragrant, perianth rose-tinged, rapids, frequent, between Grasi Falls and Posoegronoe, *23999.* Guiana, Brazil, Peru.

PASSIFLORACEAE[81]

PASSIFLORA AURICULATA H.B.K. BRITISH GUIANA: vine from low bushes, occasional on the Kaieteur Plateau, *23135.* Nicaragua, southeastward to the Guianas and the Amazon Basin of Peru, Bolivia, and Brazil. A common plant in the tropical zone, ascending to about 1200 meters altitude.

PASSIFLORA VESPERTILIO L. BRITISH GUIANA: vine with truncate leaves from low bush, fruit subglobose, purple-black, 2.5 cm. long, 2 cm. broad, Kaieteur Savanna, *23221.* Trinidad, Guiana, the Amazon Basin.

PASSIFLORA GLANDULOSA Cav. BRITISH GUIANA: vine in mora and mixed forest, frequent, Kamuni Creek, Groete Creek, Essequibo River, *22827.* Widely distributed in the Guianas and the lower Amazon Basin; also in southeastern Colombia.

PASSIFLORA COCCINEA Aubl. BRITISH GUIANA: vine or rope-like liana, 1 to 2 cm. in diameter, the scarlet flowers subtended by three large, scarlet bracts, Groete Creek, lower Essequibo River, *F1992* (*F.D. 4728*); vernacular name—Marudiyuré. SURINAM: high, mixed wallaba forest, lateritic soil, infrequent, Saramacca River, *24868;* vine, flowers scarlet, riverside above Posoegronoe, *24035;* rope, flowers orange-scarlet, low forest, vic. Black Water Camp (No. 5), Coppenam River Headwaters, *24179.* Guianas, southern Venezuela, and Amazon Basin of Colombia, Peru, Bolivia, and Brazil.

PASSIFLORA NITIDA H.B.K. BRITISH GUIANA: vine on a low tree of *Cordia,* in secondary forest, Aruka River, Northwest District, *F2372* (*F.D. 5108*); vernacular names—Merekuya, bel apple, mabaruma, fruit edible. SURINAM: cultivated at Posoegronoe, Saramacca River, *24018a.* A common species, ranging from Colombia to the Guianas, south to Peru and Goyaz, Brazil.

PASSIFLORA GARCKEI Mast. BRITISH GUIANA: slender vine growing on a tree of *Simaba,* on white sand in a Dicymbe forest, trail from Tukeit to Kaiatuk Falls, Potaro River Gorge, rare, *23056.* Known only from the three Guianas.

PASSIFLORA FOETIDA var. HISPIDA (DC.) Killip. SURINAM: frequent, Charlesburg Rift, 3 km. north of Paramaribo, old sea beach, in deep sands underlain by shells, *22742.* A common plant of the West Indies and northern South America, becoming rare in Peru and south of the Amazon.

Passiflora Maguirei Killip, sp. nov. Planta scandens, suffrutescens,

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[80] Contr. U. S. Nat. Herb. **20**: 221–235. 1919.

[81] By E. P. Killip.

ubique ovario excepto glaberrima; folia oblonga, acuminata vel breviter acuta, coriacea, penninervia; flores fasciculati; calycis tubus infundibularis, sepalis brevior; coronae filamenta 4-seriata, extima dolabriformia, alia anguste linearia et filiformia; operculum tubulosum, erectum, supra medium irreguliter laciniatum.

Woody vine with tendrils, glabrous throughout except the ovary; stipules unknown, evidently soon deciduous; petioles 1.5 to 5.0 cm. long, stout, biglandular at the apex, the glands saucer-shaped, 2 mm. in diameter, sessile; leaf blades oblong, 12 to 35 cm. long, 5.0 to 12.5 cm. wide, entire, acuminate or abruptly short-acute at apex, cuneate or rounded at the base, coriaceous lustrous on both surfaces, penninerved (principal lateral nerves about 9 to a side), reticulate-veined, the nerves and veins elevated; flowers greenish or greenish-white, borne in dense fascicles, the axis about 1 cm. long, the pedicels up to 1 cm. long; bracts subulate, about 2.5 mm. long, coriaceous; calyx tube funnel-shaped, 1.5 to 2.0 cm. long, about 8 mm. wide at the apex, tapering to the pedicel, longitudinally striate; sepals linear-oblong, 2.5 to 3.5 cm. long, 6 to 8 mm. wide, acute, fleshy; petals oblong, as long as the sepals, up to 1.2 cm. wide, obtuse, reticulate-veined near the margin; corona filaments in 4 series, the outermost linear-dolabriform, 2.0 to 2.2 cm. long, 2 mm. wide at the widest point, subulate at the apex, those of the second and third series narrowly linear, decreasing in length from 10 to 7 mm., the innermost filiform, about 3 mm. long, reflexed; operculum tubular, about 1.2 cm. long, irregularly cleft in upper half into broadly linear, truncate or rounded segments 1.5 to 2.0 mm. wide; ovary ovoid, truncate, finely puberulent.

TYPE: Kaieteur Plateau, British Guiana, May 7, 1944, *Maguire & Fanshawe 23285*. U. S. National Herbarium, no. 1,564,529.

COTYPE: Amatuk Portage, Potaro River Gorge, British Guiana, twining up aerial root of a *Clusia*, on white sand in secondary scrub forest, *23028*.

BRAZIL: Amazonas: Camanáos, Rio Negro, Ducke *34968*.

This species clearly belongs to the subgenus *Astrophea* but it does not fit well into any of the six sections given in my monograph of the family. The flowers are in dense fascicles as in certain species of Section 6, *Botryastrophea,* but they are not highly colored and the calyx tube is funnel-shaped and shorter than the sepals. The coronal structure resembles that of *P. deficiens* Mast. and probably the new species should be placed next to that. In *P. deficiens* the flowers occur singly on rather long, slender peduncles, and the calyx tube is broadly campanulate.

PASSIFLORA COSTATA Mast. SURINAM: rope-like liana overhanging banks of Saramacca River, frequent, *24948*. Surinam and British Guiana, Amazon Basin of Brazil and northeastern Peru.

PASSIFLORA FUCHSIIFLORA Hemsl. BRITISH GUIANA: liana, flowers red, on old wood, fruit dry, globose-oblong, about 4 cm. long, 4 cm. broad, infrequent, Kamuni Creek, Groete Creek, Essequibo River, *22807*. SURINAM: flowers scarlet, cauliflorus, cluster of 3-several flowers, infrequent swampy bush, rear Kwatta hede, Saramacca River, *23919*. British Guiana and Surinam.

MITOSTEMMA JENMANII Mast. BRITISH GUIANA: gray-black, rope-like liana, on the crown of a fallen tree along river, Mazaruni Station, *F2321* (*F.D. 5057*).

Apparently known hitherto only from the type, collected along the Mazaruni River by G. S. Jenman.

GUTTIFERAE

Among the more conspicuous and generally present genera on Tafelberg are *Clusia* and its congeners. This is largely true also of much of the Kaieteur Plateau where these handsome trees, shrubs, or climbers form a most impressive part of the flora. The species are clear-cut and distinctive, but some confusion is lent by diversity of form and the prevailing unisexuality of the individuals. Taxonomically the genera are not inherently difficult. Uncertainty has filled the literature because of inadequacy of much of the collected material and the lack of correlation between the sexual phases of the same species.

This review reports on 48 collections, of which 18, approximately ⅓, represent new records for British Guiana, Surinam, or both. Of the 18 new records, 10 are interpreted as representing new species.

The arrangement in this review follows that of Engler in the second edition of the *Natürliche Pflanzenfamilien*, which essentially conforms to the classic monographic studies of Planchon & Triana,[82] Vesque,[83] and Engler's[84] early treatment in the *Flora Brasiliensis*.

VISMIA CAYENNENSIS (Jacq.) Pers. BRITISH GUIANA: tree 35 feet tall, 5 inches diameter, Mabaruma, Aruka River, N. W. D., *F2374;* shrubby tree 15 feet high, Mabaruma, Aruka River, N. W. D. *F2453.* SURINAM: shrub to 3 m., flowers green, Charlesburg Rift, *22779;* flowers greenish, petals lanate within, Sectie O, km. 70, *23624;* tree 10 m. high, 7 cm. diam., petals green, fruit green, frequent, Tawa Creek, Lower Saramacca River, *23765.* Broadly distributed; Venezuela to Amazonian Brazil and Bolivia, Trinidad and Tobago.

VISMIA CONFERTIFLORA Spruce apud Reichardt. BRITISH GUIANA: small tree, creek sides and damp places, Mazaruni Station, *F626.* SURINAM: small tree, savanna, Zanderij I, *25053.* The Guianas, Brazil, Colombia and Peru; a widespread and variable species.

VISMIA MACROPHYLLA H.B.K. *V. angusta* Miq. (for detailed discussion, specific characterization and synonomy, see: Sandwith, Kew Bull. **1931**: 174; Eyma, Fl. Surinam **3**: 74. 1934). BRITISH GUIANA: low branching tree, bark brown, ribbed, panicle branches and calyx rusty, corolla palest yellow, woolly within, young fruit full grown still green, ovoid, becoming dry and woody, peculiar to swampy savannas on white sand where it is dominant with *Tabebuia longipes*, Mazaruni Station, *F627;* low spreading tree near swamp, Mazaruni Station, *F848;* very common second growth shrub to small tree, stems rusty-tomentose; almost velvety, Mahdia River, 107 mile Bartica-Potaro Road, *F990;* 107 mile Bartica-Potaro Road, *F1069.* SURINAM: small tree, low bush along Saramacca River vicinity Tawa Creek, *Maguire 23766.* Additional unreported collections are: Sandhill, *Persaud 46;* Rockstone, *Gleason 551* and *553;* Tumatumari, *Gleason 340;* Rupununi River, *la Cruz, 1744;* Pomeroon District, *la Cruz, 1853* and *3255;* Northwest District, *la Cruz 3841.* Widespread in central and tropical South America.

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82 Mem. Guttifères. 1862.

83 Guttiferae, DC. Monog. 1893.

84 Guttiferae, Mart. Fl. Bras. 12¹. 1888.

An exceedingly variable population about which there has been much confusion as to specific delimitation. It is with hesitation that *F990* and *F1069* are assigned here, because of their falcately or subfalcately oblanceolate leaves and dense pubescence. The pubescence difference is merely quantitative. The difference in basic leaf form might occur in a sufficiently self contained population to constitute an actual biologic entity.

VISMIA RUFESCENS Pers. BRITISH GUIANA: small tree 35 feet tall, 6 inches diam., Mazaruni Station, *F515*. Venezuela to Brazil. New to British Guiana.

CARAIPA RICHARDIANA Camb. BRITISH GUIANA: tree 30 feet tall, 8 inches diameter, latex yellowish, sweet-smelling, fruit green, finely striate; creekside, Arapiakow Creek, Pomeroon River, *F1234;* low-spreading tree of riparian forest, flowers white, corolla lobes reflexed, fruit dry, green, thinly woody, Essequibo River by Agatash, *F1329*. British Guiana to Amazonian Brazil.

CALOPHYLLUM BRASILIENSE Camb., sensu lato. BRITISH GUIANA: tree 30 feet high, 6 inches diameter, leaves leathery, brittle, inflorescence axillary, fruit globose, Bakuyahana Creek, Aruka River, *F2439*. Central America, the West Indies, and tropical South America.

Recently Eyma[85] has reviewed the Guttiferae in the Flora of Surinam. His excellent treatment has served well in the study of present materials, particularly for *Clusia,* because nowhere otherwise since the Monograph of Vesque has the record for the Guiana species of this genus been brought together.

CLUSIA CUNEATA Benth. Sect. *Clusiastrum*. BRITISH GUIANA: small terrestrial tree to 4 m. high, inflorescence nodding, flowers white, sepals 8 imbricate, petals 8 (10) imbricate, androecia sometimes completely sterile, on white sand, secondary scrub forest, Amatuk Portage, Potaro River, *23012;* Kaieteur Savanna: low branched bushy shrub to 2.5 m. high, latex scanty, flowers white, stigmas peltate, raised, fruit oblong, 14–16 locular, 4.5 cm. long, 1.4 cm. broad, occasional, *23325* ♀ ; data as above, *23325a* ♂ ; thickly branched tree to 3 m., flowers white, non-fragrant, *23462* ♂ *; thickly* branched tree, flowers fragrant, occasional, *23463* ♀ ; shrubby rounded tree 2–3 m., flowers white, petals delicate, stigmas disciform, elevated, occasional to frequent, *23259* ♂. British and French Guiana.

The oldest members of the section *Clusiastrum* are *Clusia fragrans* Gard. and *C. cuneata* Benth. The first, of which no material has been seen, is described as having a 5–6-loculate ovary, 4 decussate sepals, and 5 petals; it therefore would seem to have tenuous relationship indeed with *C. cuneata*. There is ample material of *C. cuneata* now available; hence the species is adequately known. It has in common with its closest relatives short internodes, cuneate, coriaceous leaves with short petioles, the higher numbers of imbricate perianth segments, distinctly free styles, and (14) 16-locular ovaries.

CLUSIA CRASSIFOLIA Pl. & Tr. Sect. *Clusiastrum*. BRITISH GUIANA: Kaieteur Savanna: open-crowned tree to 7 m. tall, flowers white, occasional, *23460* ♀ ; tree 2 m. tall, grows to 8 m., occasional, *23461* ♀ . Known only from British Guiana.

[85] Fl. Surinam 3: 65–160. 1934.

Both collections are of pistillate material, the flowers yet in bud. Dissection reveals 16 typical distinct slender styles, indicating the 16-locular ovary, by which the Section *Clusiastrum* is so surely recognized. In our specimens there are 7 sepals, the lower pair representing those interpreted as "bractioles" by Eyma.[86] These are decussate. The remainder are more or less imbricate, but there is no disjunction between the two sets. The lower pair in this and other species of the section seems to be the homologue of the decussate members where there is a total of but 2 or 4 "sepals."

Vesque[87] describes *C. crassifolia* merely with ". . . calyce 4-phyllobibracteato, petalis 6 ovatis . . ." The assignment of the two Kaieteur collections to *C. crassifolia* is only tentatively made, since no authentic material of the species is available, and the general circumscriptions are inadequate for definite identification.

Clusia stylosa Maguire, sp. nov. Sect. *Clusiastrum.* Arbor terrestris 10 m. alta; foliis (15) 20–40 cm. longis, coriaceis late obovatis vel oblanceolatis, subsessilibus, petiolis alatis vel subauriculatis; inflorescentibus compactis, 3–15-floribus; sepalis 7–10 imbricatis vel subdecussatis; petalis 7–8; staminibus numerosis, 100+, filamentis linearibus, 1.5–2.0 mm. longis, antheris linearibus 2.5–3.0 mm. longis florum staminodia femineorum anantheris numerosis, 4–5 mm. longis, 4–6-seriatis, corona 1 mm. alta disposita, ovariis 16-locularibus, stylis 16, 3–3 mm. longis, radiatis, stigmatibus sessilibus, obovatis, ca. 1 mm. longis.

Terrestrial, tree to 10 m. high; latex scanty, yellow, branchlets coarse, more or less terete, not conspicuously angled; leaves (15) 20–40 cm. long, (8) 10–15 cm. wide, coriaceous, broadly obovate to oblanceolate, the apex rounded, from above the middle, the blade gradually narrowed to the base, the petioles 1.5–3.0 cm. long, but broadly winged and frequently subauriculate, hence the leaves appearing sessile, the midrib not prominent above, strongly so, elevated and rounded below, the essentially straight primary nerves prominent below, less so above, 8–10 mm. apart, ascending in a 30° angle, and collected in a peripheral vein 3–4 mm. from the blade margin, secondary vein only a little less prominent; inflorescence compact, 3–15-flowered, peduncles stout, 3–8 cm. long, primary bracts 1.5–2.0 cm. long, obtuse, secondary bracts usually ca. 8 mm. long, obtuse or apiculate, the ultimate 5–6 mm. long; staminate flower: sepals 7–10, imbricate or subdecussate, concave, suborbicular, 1.5 cm. long, with scarious margins, the innermost oblong-obovate or oblong-ovate, smaller, petals, 7–8, obovate, 3 cm. long, wholly white, receptacle plane or somewhat convex, stamens numerous, considerably exceeding 100, 4–5 mm. long, the filaments slender, ca. 1.5–2.0 mm. long, anthers linear, dehiscing along the apical 1.5 mm., tardily or not dehiscing for their entire length; pistillate inflorescence densely compact, primary bracts 1.5 cm. long; pistillate flower: sepals 10, more or less imbricate, the outer paired, and broadly suborbicular-reniform, 1 cm. long, 1.5 cm. broad, the succeeding larger, ca. 15 mm. long, suborbicular, the innermost somewhat reduced; petals unknown; staminodia anantherous, numerous; 4–5 mm. long, linear 5–6 serial, free, bornė on a low wing ca. 1 mm. high, ovary 16-celled, ovules numerous, biseriate, axial,

[86] Meded. Bot. Mus. Utrecht 4: 11. 1932.

[87] DC. Monog. 8: 69. 1893.

sessile; fruit oblong, narrowed at the summit into a crateriform beak 2–4 m. long, styles 16, free, 3–5 mm. long, radiating, stigmas sub-basally sessile, obovate, ca. 1 mm. long; mature fruit probably exceeding 3 cm. in length.

TYPE: common, *Clusia* bush, line between Savanna VIII and southwest escarpment, Tafelberg, Surinam, September 5, 1944, *Maguire 24625* ♀. New York Botanical Garden.

Clusia stylosa is known only from Tafelberg, but is commonly distributed there in dense low bush and about the frequent openings. Three collections aside from the type represent the species: common, *Clusia* bush near Savanna VIII, *24626* ♂; tree to 10 m. high, 15 cm. diameter, latex scant, yellow, flowers and bracts totally white, flowers 6–8 cm. diameter, open area on rocks, base of south escarpment, 200 meters west of Grace Falls, Arrowhead Basin, *24508* ♂; tree 10 m. tall, flowers totally white, 6–8 cm. diameter, frequent *Clusia* bush, 1 km. Savanna VIII, *24545*.

Clusia tabulamontana Maguire, sp. nov. Sect. *Clusiastrum*. Arbuscula terrestris 7 m. alta; foliis sessilibus vel petiolatis, ellipticis, late obtusis, coriaceis; inflorescentibus 1–3-floribus; sepalis 12–14; petalis 8; florum feminearum staminodia numerosis, linearibus, anantheris, 4–6-seriatis, corona 1 mm. alta disposita; ovariis 16-locularibus, stylis 16, 2–4 mm. longis, linearibus, stigmatibus oblongis ca. 2 mm. longis, sessilibus; fructibus oblongo-ellipticis, 3–4 cm. longis.

Terrestrial, small open-branched tree to 7 m. high; branchlets coarse, more or less terete, the internodes 1.5–2.5 cm. long; leaves sessile or the petiole less than 5 mm. long, the blade 10–16 cm. long, 5–7 cm. broad, elliptic, broadly obtuse at the apex, hardly less so at the base, coriaceous, the midrib little raised on the upper surface, conspicuously so beneath, the veins ascending at a 45° angle, the primary straight, almost equally prominent on both surfaces, collected into a crenated peripheral vein 2.5–3.5 mm. from the margin, secondary veins little less prominent than the primary; inflorescence 1–3-flowered, peduncle to 6 cm. long, 5 mm. thick, pedicels at maturity 3–5 cm. long, becoming transversely corrugated below the calyx, primary bracts obtuse, 1 cm. long, secondary bracts usually basal on lateral pedicels, the secondary obtuse, 3–5 mm. long, 1–2 cm. below the calyx on the central one; sepals 12–14, the outer opposite, the inner becoming more or less imbricate, the outermost pair suborbicular and connate, ca. 8 mm. long, the immediately succeeding members largest, to 1.5 cm. long and 1.8 cm. broad, the inner becoming thinner, more oblong, with narrow bases, petals 8, obovate, 3–4 cm. long, white, more or less distinctly clawed, the margins crimped and erose; staminodia 4–5 mm. long, numerous, free, linear, completely sterile, 4–6-seriate on a shallow ring, 1 mm. or less high; ovary 16-celled, ovules numerous, 2-seriate, sessile, axial; styles 16, 2–4 mm. long, linear, free, radiating from a crateriform beak 1–3 mm. long, stigmas obovate-oblong, ca. 2 mm. long, subbasally attached, articu-

Explanation of figure 18

FIG. 18. *Clusia stylosa* Maguire. *Maguire 24625* ♀. 1, upper surface of leaf, ×½; 2, young fruit showing sepals, ×1; 3, mature fruit with sepals removed showing staminodia, ×1; 4, diagram of cross section of fruit, ×1. *Maguire 24626* ♂. 5, staminate flower, ×½; 6, stamen, ×10. *Clusia tabulamontana* Maguire. *Maguire 24393* ♀. 7, pistillate flower, ×½; 8, diagram of cross section of fruit, ×1; 9, tangential section of fruit, ×1; 10, upper surface of leaf, ×½.

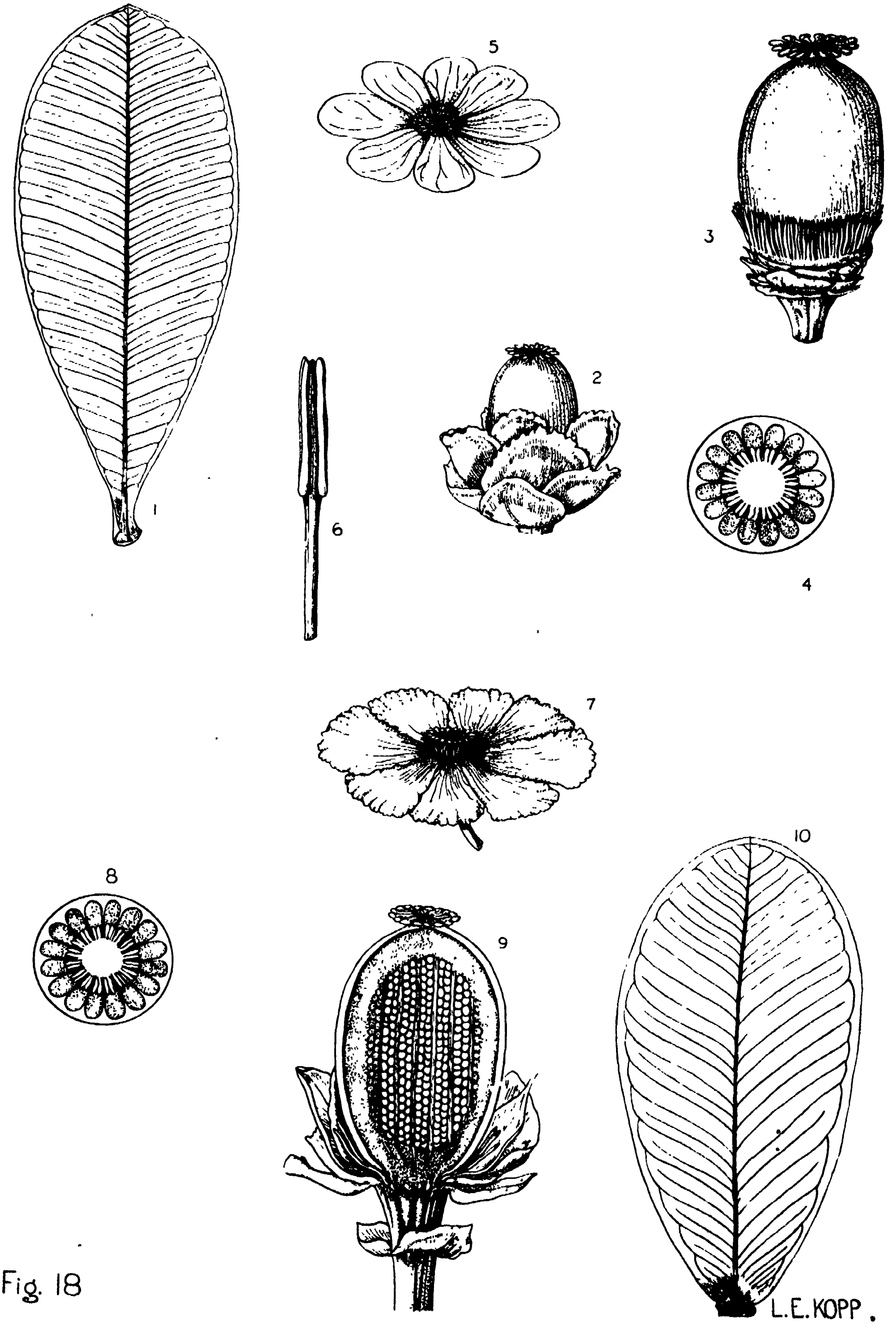

Fig. 18

lated; fruit oblong-elliptic, 3–4 cm. long, seeds oblong-obovoid, ca. 3 mm. long; staminate flower unknown.

TYPE: small branched tree to 5 m. high, petals white, fragile, crimped and erose along the margin, frequent, edge of Savanna V, Tafelberg, Surinam, August 16, 1944, *Maguire 24396* ♀. New York Botanical Garden.

Also known only from Tafelberg. The two other collections both likewise from pistillate trees are: rather open tree 7 m. tall, on edge of bush, pedicels and fruit reddish, frequent, Savanna II, *24245;* mature fruit nearly 4 cm. long, Savanna II, *24738.*

Clusia tabulamontana and *C. stylosa* are closely interrelated as demonstrated by the almost identical remarkable free radiating styles, with crateriform bases, almost unique in the genus, whereas the stigmas are characteristically sessile. The nearest relative seems to be *C. cuneata* of British Guiana, in which there is likewise an even more conspicuous crateriform style base, but in which the free portion of the style is short. The three species form a natural group by virtue of general habit, leaf form, higher numbers of imbricate sepals, numerous similar stamens, 16-locular ovaries, and striking style character. These three constitute the known species definitely to be placed in the section *Clusiastrum* Planchon and Triana (l.c.), the circumscription of which was largely based on *Clusia cuneata.*

CLUSIA MELCHIORI Gleason. Sect. *Anandrogyne.* SURINAM: diffuse tree, latex clear, scanty, drying amber, common, overhanging east escarpment, 2 km. south of East Ridge, *24585* ♀; data as for preceding, *24585a* ♂; *Clusia* bush, line between Savaanna VIII and southwest escarpment, *24641.* Previously known only by the type, *Tate 705,* from Mt. Duida, Venezuela, and *Pinkus 161* from Mt. Roraima, Venezuela. Our specimens seem to have somewhat smaller fruit and larger, thinner leaves, quantitative differences that do not warrant specific segregation. Hitherto, only specimens with young fruit have been at hand. Now the description may be further amplified in the light of the newly collected staminate material: bracts 4, keeled, 1–1.5 mm. long, acute, the second pair closely subtending the calyx, sepals 4, decussate, membranous, suborbicular, 3–4 mm. long, petals 4, broadly obovate, 5–6 mm. long, the base reddish, stamens 15–20, free, the outermost ca. 2 mm. long, with filaments 1 mm. long, the inner ca. 3 mm. long, with the red filaments ca. 2 mm. long, filaments fairly slender, continuous with the connective which is somewhat surpassed by the anther lobes, anthers marginal, linear, dehiscing lengthwise.

Clusia savannarum Maguire, sp. nov. Sect. *Anandrogyne.* Arbuscula 3 m. alta, terrestris; laminis foliorum suborbicularibus vel late oblongo-obovatis, 4–7 cm. long, 3–5 cm. latis, coriaceis; inflorescentibus 3–7-floribus;

Explanation of figure 19

FIG. 19. *Clusia mutica* Maguire. *Maguire 23257* ♂. 1, upper surface of leaf, × ½; 2, bud, × 1; 3, staminate flower, × ½; 4, portion of the staminal ring, × 3; 5, stamen, × 10. *Maguire 23258* ♀. 6, young fruit, showing sepals, × ½; 7, nearly mature fruit, showing staminodia, × 1; 8, diagram of cross section of mature fruit, × ½.. *Clusia lunanthera* Maguire. *Maguire 24422* ♂. 9, upper surface of leaf, × ½; 10, staminate flower, × ½; 11, portion of staminal ring, × 2; 12, stamen, × 10. *Maguire 24428* ♀. 13, young fruit showing sepals, × ½; 14, nearly mature fruit showing staminodia, × 1; 15, diagram of cross section of nearly mature fruit, × ½.

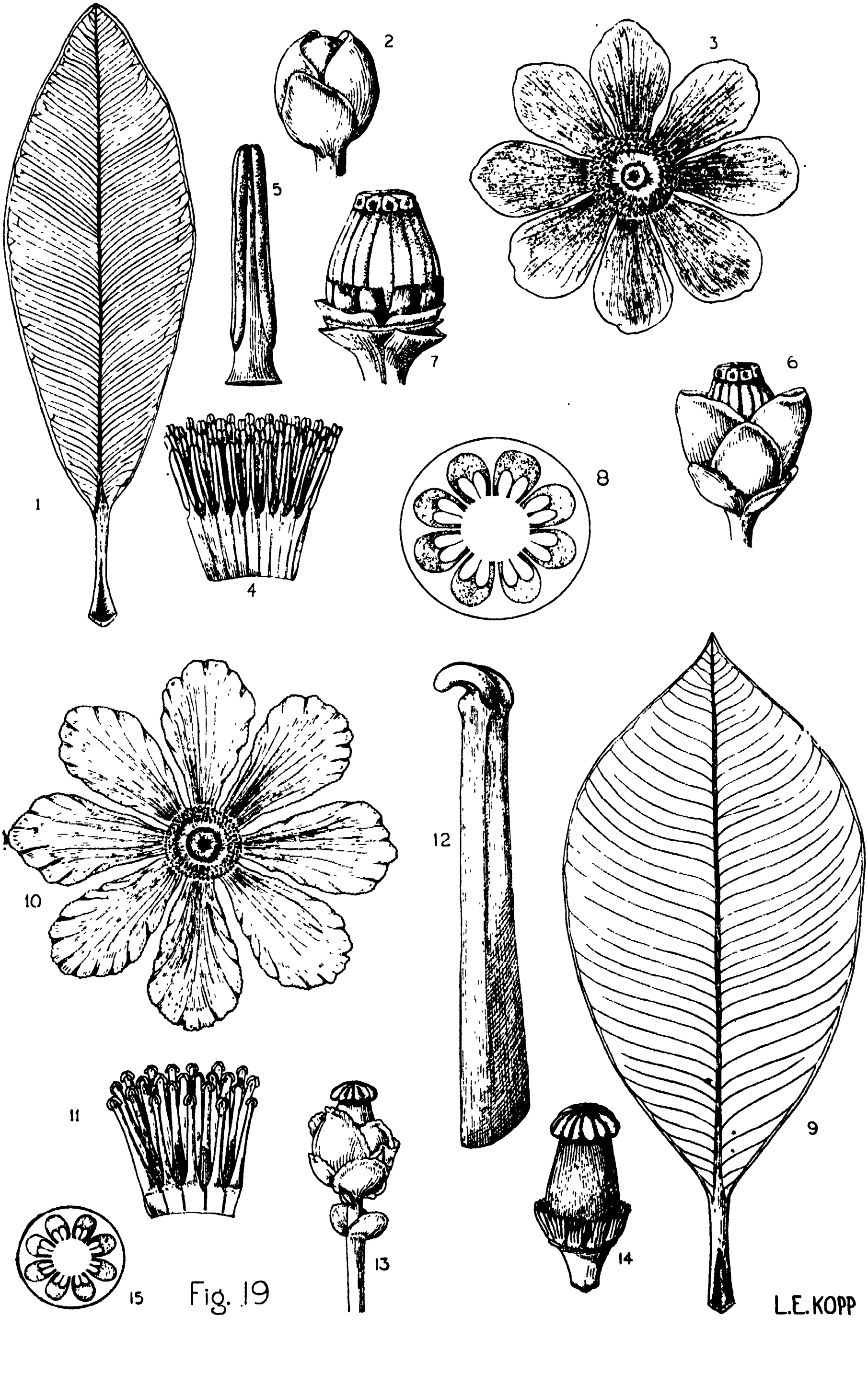

Fig. 19

floribus pistillatis: sepalis 4, decussatis, petalis 5; staminibus 10, antheris functionalibus; ovariis 5-locularibus, locularibus 2-ovulatis, pendentibus; stigmatibus sessilibus, peltatis, late ovato-globosis.

Terrestrial, shrubby tree to 3 m. tall; branchlets fairly stout, internodes 1–2 cm. long; petioles thick, 5 mm. or less long, vaginal pits deep, with conspicuously raised margins, blades suborbicular to broadly oblong-obovate, (3) 4–7 (8) cm. long, 3–5 (7) cm. broad, coriaceous, midrib little more prominent below than on upper surface, veins inconspicuous, ascending at 35°–45° angle, straight, the primary 3–4 mm. apart; influorescence (1) 3–7-flowered, peduncle, 8–12 mm. long, pedicels 2–3 mm. long, primary bracts acute, ca. 3 mm. long, secondary bracts obtuse, scarious margined, ca. 3 mm. long; pistillate flowers: sepals 4, decussate, broadly ovate to suborbicular, 5–7 mm. long, scarious margined, petals (4) 5, somewhat fleshy, 7–10 mm. long, obovate; stamens 10, filaments connate at the base, 1 mm. long, anthers oblong-ovate, 1.0–1.5 mm. long, exceeding the connective, apparently dehiscing lengthwise; ovary (4–) 5-celled, ovules 2 per loculus, pendulous, stigmas more or less rounded, peltate, sessile on short stout stylar processes; fruit 1–1.5 cm. long, broadly ovate-spheroid, explanately dehiscing, seed ca. 6 mm. long.

TYPE: shrubby tree 2–3 m. high, leaves ovate to rounded, ripe fruit yellow-green, occasional in bush islands, Kaieteur Savanna, British Guiana, May 6, 1944, *Maguire & Fanshawe 23267*. Known only from the type locality. New York Botanical Garden.

This species resembles somewhat *C. rotundifolia* Gleason of Mt. Duida, which has orbicular, sessile, very thick leaves, and a 4-celled ovary with "numerous seeds."

CLUSIA FOCKEAÑA Miq. Sect. *Androstylum*. SURINAM: petal base deep red, rope strangler, frequent, high mixed wallaba forest below talus, north base Tafelberg, *24843*; small tree, petals with red bases, frequent, Savanna II, Tafelberg, *24266*; small tree, petals white with deep maroon base, frequent, Savanna II, Tafelberg, *24237*. Guiana; common in Surinam. It is not improbable that some of the fruiting material that has been generally referred to *C. nemorosa* actually belongs here. In habit, leaf, and petal character the two species are very similar. I am not clear as to separation by fruit character.

Clusia Stahelii Maguire, sp. nov. Sect. *Androstylum*. Arbuscula terrestris; foliis laminibus chartaceis, elliptico-obovatis vel oblanceolatis, basibus acutis, apicibus abrupte acutis vel acuminatis, marginibus revolutis, nerviis subaequaliter supra et subtus prominulis; inflorescentibus 1–3-floribus; sepalis 4, subdecussatis, petalis 5, imbricatis; androeciis columnaribus diste capitularis, staminodiis numerosis; ♀ floribus incognitis.

Explanation of figure 20

FIG. 20. *Clusia savannarum* Maguire. *Maguire & Fanshawe 23267*. 1, upper surface of leaf, ×1; 2, flower, ×2; 3, stamen, ×10; 4, nearly mature fruit, showing sepals, ×2; 5, mature fruit in long-section, ×2; 6, diagram of cross section of fruit, ×2. *Oedematopus quadratus* Maguire. *Maguire 24238* ♂. 7, upper surface of larger leaf, lower surface of smaller, both ×1; 8, section of quadrangular branchlet, ×1; 9, bud, ×3; 10, expanded flower from below, ×2; 11, androecium, ×5; 12, stamen, ×10. *Maguire 24248* ♀. 13, expanded flower from above, ×2; 14, mature fruit, ×2; 15, diagram of fruit in long-section, ×2; 16, diagram of fruit in cross section, ×2.

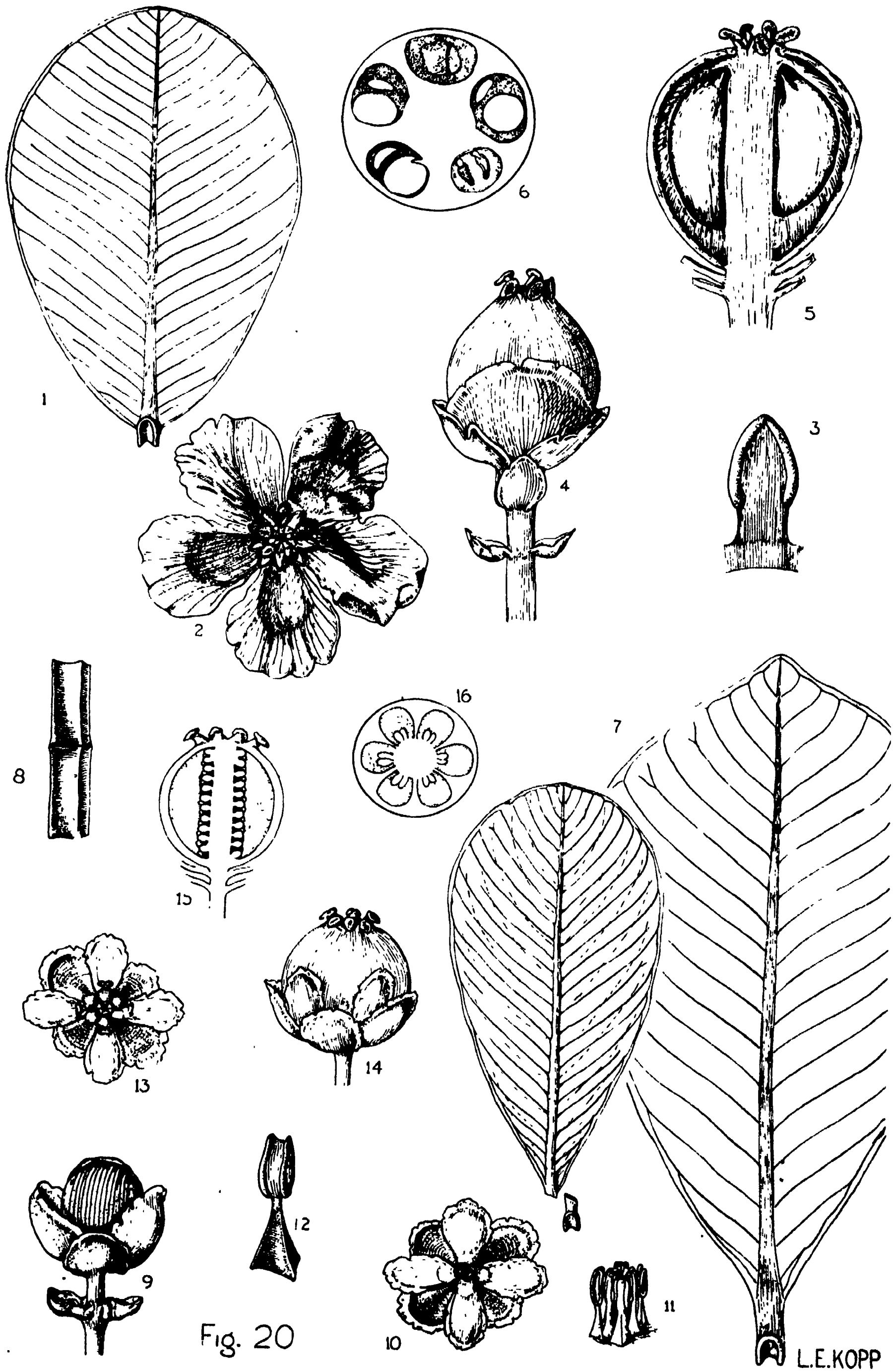

Fig. 20

Terrestrial, small tree; branchlets slender, more or less terete, internodes mostly 3–10 cm. long; petioles 1.0–1.5 (2.0) cm. long, petiolar pit ca. 3 mm. broad, flat, cartilaginous, with thick raised, distally rounded margins, blades chartaceous, elliptic-obovate to oblanceolate, the base acute, the apex rather abruptly acute or acuminate, the margins slightly involute, veins more or less equally prominent on both surfaces, the primary usually 2.5–3.5 mm. apart, ascending at a 45°–55° angle, somewhat upwardly curved towards the margins and collected in a peripheral nerve less than 1 mm. from the margin, the secondary almost equally prominent, not or feebly extending to the marginal nerve, darker latex canals more or less prominent, more sharply ascending and intersecting the veins; inflorescence 1–3-flowered, nodding, the peduncle 1.5–2.0 cm. long, pedicel slender, 1.5–2.5 cm. long, primary and secondary bracts broadly triangular, ca. 2 mm. long, acutish; sepals 4, the first pair subopposite, the pairs 6–7 and 8–9 mm. long respectively, oblong-ovate, concave; petals 5, 10–12 mm. long, more or less imbricate, broadly orbiculate, obovate, shallowly and irregularly lobed and crenate, abruptly short-clawed; androecium columnar, surmounted by a globose capitulum formed by numerous small compacted stamens, the filaments linear, 0.5–0.75 mm. long, closely prismatic by compression, anthers 4-lobed, oblong, 0.5 mm. long, the staminal column surrounded by a dense ring of prismatic multiseriate staminodia 1.5 mm. high.

TYPE: small tree, grass savanna, Zanderij II, Surinam, *Maguire & Stahel 23650*. New York Botanical Garden. Named in honor of Professor Gerold Stahel, co-collector and eminent botanist of Surinam.

This species belongs to the small, well defined Section *Androstylum* in which the androecium forms a knobbed column. Its close relative *C. Fockeana* is one of the more frequently encountered species at Zanderij. *C. Stahelii* stands very distinct from it in the very different leaf character and much smaller flowers. *C. Stahelii* unfortunately was not recognized in the field and was collected fragmentarily, being confused with *C. parvicapsula* which it superficially resembles.

CLUSIA PURPUREA Engl. Sect. *Phloianthera*. SURINAM: small tree with whitish latex, stigmas white, fruit subglobose, strongly transversely wrinkled, seed red, aril orange, copious, frequent, rocks Gran Dam, Saramacca River, *24934*. Known only from Surinam.

CLUSIA GRANDIFLORA Splitgerber. Sect. *Euclusia*. BRITISH GUIANA: branching tree to 8 m. high, latex scanty, flowers white, 15–18 cm. diam., frequent, Kaieteur Savanna, *23333* ♂. SURINAM: strangler in mixed high forest, km. 7, Saramacca River Headwaters, *24884* ♀. British and Dutch Guiana.

CLUSIA INSIGNIS Mart. Sect. *Euclusia*. SURINAM: rope 10 cm. diam. in summit of tall wallaba, petals broadly obovate, 5 cm. long, white fertile stamen 8–10-seriate, fruit subglobose, 2.5 cm. broad, 2.5 cm. high, 10-celled, ovules numerous, stigmas 10, closely connate into a thick truncate disc ca.

Explanation of figure 21

FIG. 21. *Clusia Stahelii* Maguire. *Maguire & Stahel 23650*. 1, lower surface of leaf, ×1; 2, bud, ×2; 3, petal, ×2; 4, androecium, ×4; 5, long-section of staminal capitulum, ×6; 6, anther, ×20. *Rheedia Martini* Maguire. *Maguire 24427* ♂. 7, lower surface of leaf, ×1; 8, staminate flower, ×2; 9, petal, ×4; 10, stamen, ×10; 11, anther, ×20.

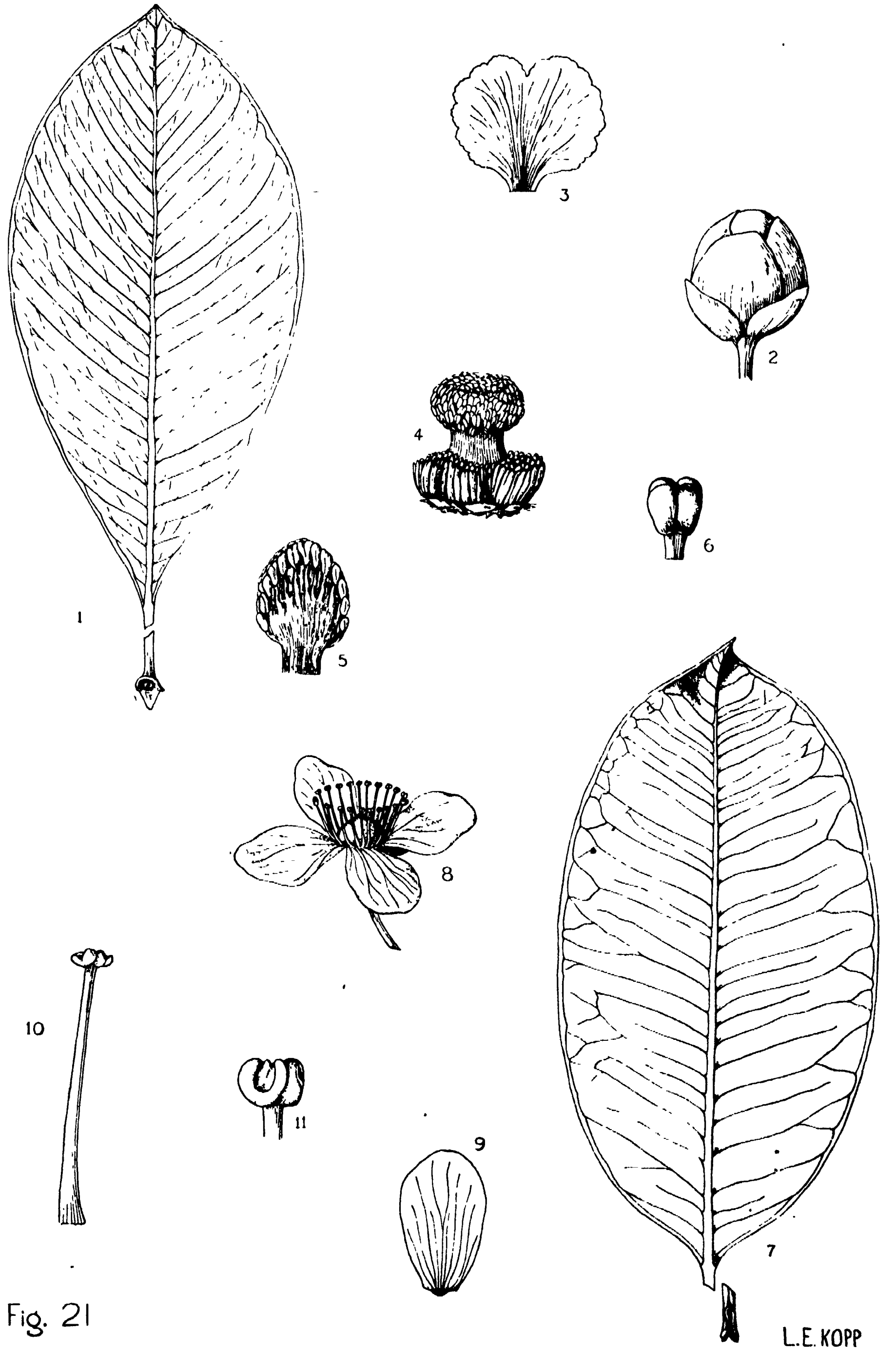

Fig. 21

4 mm. high and 8 mm. broad, Hill I, between North Ridge Creek and Augustus Creek, Tafelberg, *24721a* ♂ ; Hill I, between North Ridge Creek and Augustus Creek, Tafelberg, *24721b* ♀. Hitherto known only from Amazonas; the fruit apparently collected here for the first time.

Clusia mutica Maguire, sp. nov. Sect. *Euclusia.* Arbor stricta, terrestris; foliis petiolatis, laminis magnis, ellipticis vel oblanceolatis, apicibusque basibus subcuneatis, acutis, vel apicibus late obtusis, subcoriaceis, nerviis aequaliter supra et subtus prominentibus; inflorescentibus 1–3-floribus; floribus staminatis: sepalis 4, decussatis, petalis 8; staminibus numerosis, in coronae dispositis, filamentis ad bases bulbosis, antheris muticis; staminodiis numerosis, in massis centralis glutinosis; floribus pistillatis: sepalis 6, decussate, staminodiis 2–3-seriatis, cupulatis; ovariis 8-loculis; stigmatibus 8; fructis magnis, obovato-globosis, stigmatibus centralibus depressis, seminibus oblongis.

Strict tree to 4 m. tall, 4 cm. diam., branches terete; leaf petioles 3–4 cm. long, the blades 15–35 cm. long, 6–10 cm. wide, elliptic to oblanceolate, the apex and base both subcuneately acute, or the apex more or less rounded, red-margined, subcoriaceous, midrib not prominent above, strongly so on the lower surface, primary vein ascending to the margin at a 45°–50° angle, somewhat curved, 2–4 mm. apart, the secondary hardly less conspicuous, equally prominent on both surfaces, the darker latex vessels on drying frequently becoming conspicuous, rising more sharply, thereby intersecting the veins; inflorescence 1–3-flowered, peduncles 2–3 cm. long, usually recurved, primary bracts 1.5 cm. long, acutish, naviculoid, strongly keeled, pedicels 1 cm. long or less, secondary bracts closely subtending the flower, broadly ovate, keeled, ca. 1 cm. long; staminate inflorescence 3-flowered, sepals 4, decussate, the outer semiorbicular, 1.6–2.0 cm. long, the inner less broad, 1.8–2.2 cm. long, petals 8, oblanceolate to obovate, 3–4 cm. long, white; fertile stamens borne on a broad annulus, numerous filaments ca. 0.5 mm. long, enlarged, almost bulbous, anthers ca. 3 mm. long, linear, the thecae dehiscing longitudinally throughout, connective muticous, staminodia numerous forming a completely agglutinated central mass, pistillate structures completely absent; pistillate inflorescence apparently single-flowered, peduncle 2.0–2.5 cm. long, bracts approximate, ovate, keeled ca. 1 cm. long, sepals 6, decussate, the outer 1.5 cm. long, broadly ovate, the intermediate suborbicular, 2 cm. long, and the inner 3 cm. long, broadly obovate, subpetaloid; petals not seen; staminodia 2–3-seriate, cupulate, 5–6 mm. high; ovary oblong-ovoid, 8-celled, ovules numerous, stigmas 8, triangular, connate, the stigmatic body broadly truncate and depressed at the summit; mature fruit broadly ovate-globose, 5–6 cm. long, 6–8 cm. broad, the stigmas centrally depressed, dehiscing by 8 (7–9) valves, seed oblong, 5–6 mm. long, 2.5–3.0 mm. broad.

TYPE: strict tree to 4 m. tall, 4 cm. diam., leaves oblanceolate, red-margined, bracts pink, flowers white, 10–12 cm. broad, expanded, occasional, Kaieteur Savanna, British Guiana, May 6, 1944, *Maguire & Fanshawe 23257* ♂. New York Botanical Garden.

Known only from the Kaieteur Savannas, and in addition by a collection of the same data as the type, *23258* ♀ cotype. *C. mutica* is assigned tentatively to the section *Euclusia* because of its close resemblance to *C.*

grandiflora, differing in its narrower, thinner leaves, smaller flowers, muticous anthers and 8-celled ovary.

CLUSIA NEMOROSA G. F. W. Meyer. Sect. *Euclusia.* BRITISH GUIANA: small, open-branched tree, buds pink, petals with deep red centers, occasional, Kaieteur Savanna, *23464;* tree to 30 feet tall, 4 inches diameter, stilt-rooted with thick white latex, Kaituma River, *F2403,* questionably referred to *C. nemorosa.* SURINAM: small ♀ tree 2 m. high, only specimen seen, Savanna II, Tafelberg, *24246* questionably referred to *C. nemorosa;* small ♂ tree, petals with red bases, frequent, Savanna II, Tafelberg, *24265;* ♂ tree to 12 m. tall, 15 cm. diam., latex lacking, petals red toward base, frequent dense low bush, 1.5 km. southeast Savanna I, Tafelberg, *24421;* ♀, petal bases red, frequent, strangler on tree overhanging stream, North Ridge Cascade, Tafelberg, *24672;* ♀ tree, bracts and flowers totally white, overhanging cliffs, frequent, west escarpment, Tafelberg, *24681*; ♂ tree, bracts pink, petals red at base, overhanging cliffs, west escarpment, Tafelberg, hanging cliffs, frequent, west escarpment, Tafelberg, *24681;* ♂ tree, bracts *24682;* tree to 5 m. high, stems sharply quadrangular, Grasi Falls, Saramacca River, *24938;* south savanna, Zanderij I, 24984, questionably assigned; Zanderij II, *43650* ♂. Variable and widespread from southern Brazil, through the Guianas to southern Venezuela and Trinidad.

CLUSIA PALMICIDA L. Sect. *Euclusia.* BRITISH GUIANA: tree 3 m. high, 4–6 cm. diam., leaves broad-elliptic, calyx and bracts crimson, fruit green, occasional on bush islands, Kaieteur Savanna, *23269;* frequent, banks and swamps along Kamuni Creek, Groete Creek, Essequibo River, *22940.* British Guiana, Surinam, French Guiana.

CLUSIA ROBUSTA Eyma. Sect. *Euclusia.* SURINAM: shrub or small tree to 8 m., flowers staminate, sepals 6, suborbicular, to 2.5 cm. long and broad, petals 8, 3–4 cm. long, broadly obovate, ovate, or oblong, fleshy, white; stamens numerous, the fertile borne on the margins of a cup raised ca. 8 mm. high, the central stamens or staminodia borne on a flat disc 1–1.5 cm. broad, the filaments free, thick, the thecae parasitized, perhaps often fertile; frequent about borders of openings, Savanna VIII, Tafelberg, *24569;* a second collection with fruit to 8 cm. in diam. and 6–7 cm. long, stigmas 10, sessile, adnate, narrowly triangular, ca. 1 cm. long, ovary 10-celled, seed numerous in an orange pulp, frequent, Savanna VIII, Tafelberg, *24570.* Known previously only from the type with immature staminate flowers collected on Hendrik-Top, some 75 km. north of Tafelberg.

CLUSIA ROSEA L. Sect. *Euclusia.* SURINAM: pistillate tree to 18 m., 30 cm. diam., petals striped and suffused with red, frequent, mixed transition high and low bush, 0.5 km. southwest Savanna I, Tafelberg, *24794.* Previously unreported from Surinam, widely distributed from the Guianas northward into Central America and the West Indies. In our specimen leaves have longer petioles than is typical, but otherwise they seem to fit into *C. rosea.*

CLUSIA COLORANS Klotzsch ex Engl. Sect. *Pseudo-Quapoia.* BRITISH GUIANA: flowers yellowish, anthers orange, shrubby to 4 m. high, branches to 6 m. long, frequent, Kaieteur Savanna, *23334* ♂; Kaieteur savanna, *23335* ♀. SURINAM: small tree, base of petals red, frequent, island in rapids, Saramacca River, between Jacob kondre and Kwatta hede, *23900.* Guiana; hitherto unreported from Surinam. Plants assigned here are those

belonging to the section *Pachystemon* Engl. subsect. Quapoiy (Aubl.) Engl., having the pericarp of the fruit smooth and not transversely wrinkled. The type was described from staminate material, *R. Schomburgk 1707*, hence original pistillate material is non-existent.

CLUSIA PANA-PANARI (Aubl.) Choisy. Sect. *Pseudo-Quapoia.* SURINAM: small tree to 10 m., rounded, much-branched crown, ♀ plant, island in Brokoboto Rapids, 3 hours above Pakka Pakka, Saramacca River, *23989;* tree 15 m. high, 30 cm. diam., latex yellow, ♀ plant, rocky slopes, opening, Grace Falls, Tafelberg, *24489.* Material, so attributed, widely distributed in Surinam and British Guiana.

The above two collections seem to conform to *C. pana-panari* as interpreted by Eyma.[88] This interpretation is based on Eyma's study of the Aublet type in the British Museum and on the historical acceptance of the name, in which the fruits are small with 5 stigmas and transversely wrinkled pericarps. But Aublet's plate[89] (not withstanding the discordant nature of other figures of the plate) shows a fruit definitely not wrinkled, and an annotation, signed by N. E. Brown on the New York Botanical Garden sheet of *Hitchcock 17370* from British Guiana, reads in part: "I had first thought that this . . . might be *C. pana-panari* Ch. but on comparing it at the Brit. Mus. with Aublet's type, I find that it is not that species which has shorter petioles and fruit just as Aublet figures it, not transversely wrinkled as here. This *17370* seems to be only a form of *C. colorans* Engl." Thus it would seem possible that plants with wrinkled fruit (including the 2 Surinam specimens reported here) should not be considered a part of *C. pana-panari.* But in the large body of collected material going under the name of *C. colorans* there is an almost equal quantity of plants with smooth fruit and of plants with wrinkled fruit, conditions that are not likely to be characteristic of a single species.

CLUSIA JENMANI Engl. Sect. *Polythecandra.* BRITISH GUIANA: tree 3 m. high, 6 cm. diam., leaves crowded toward branchlet ends, leathery, fruit broadly ovoid, green, glossy, all parts exuding a sticky creamy-orange latex, occasional on rock at gorge edge, Kaieteur Plateau, *23124*; bushy tree 3–4 m. high, 4–6 cm. diam., calyx and bracts pale green, fruit broadly ovoid, glossy green, occasional, bush island on Kaieteur Savanna, *23277.* Known only from British Guiana; type locality Kaieteur Savanna.

CLUSIA PARVICAPSULA Vesque. SURINAM: small rounded tree or shrub, latex white, flowers white, frequent, rocks, Gran Dam, Saramacca River, *24933* ☿. No authentic material of *C. parvicapsula* has been available for study. The above collection seems referable to this species but differs, possibly significantly, from the descriptions as offered by Vesque[90] and amplified by Eyma.[91] In our plants the leaves are rhombic or obovate-cunate the principal ones only 5–7 cm. long and 2.5–4.0 cm. broad, hardly more than chartaceous and the margins not involute, the staminodial ring fleshy, ca. 1.5 mm. high, bearing 5 more or less equally spaced groups of (2) 4–5 radially disposed stamens, the anthers of which are evidently functional; the 6–7 large wedge-shaped stigmas connate and umbraculiform when im-

[88] Meded. Bot. Mus. Utrecht 4: 16. 1932. Fl. Surinam 3: 97. 1934.
[89] Hist. Pl. Gui. 4: *pl. 344.* 1775.
[90] Epharmoses 3: *pl. 34.* 1892.
[91] Fl. Surinam 3: 99. 1934.

mature, but rotate when mature. Eyma (l.c.) offers the following contrastive circumscription: " . . . ; lamina obovate to obovate-cuneate, . . . , 6–13 cm. l., coriaceous, margin recurved; . . . ♀ or ☿ flower: staminodial ring fleshy, cup-like, light brown, bearing some more or less developed anthers (also fertile ones?) on its outer surface, rarely anantherous." It would seem that the species should be sufficiently variable to accommodate plants as delimited by Eyma and our own collections with much smaller thinner leaves.

Eyma[92] in an earlier discussion suggests that *C. utilis* Blake[93] belongs with the above species. In my opinion also, it is very close indeed if not conspecific.

Apparently all of the specimens collected to date, including those of *C. utilis*, have been of fruiting material with functional anthers. It seems unlikely that this is merely the result of coincidence, but more probably that *C. parvicapsula* is one of the few species with normally hermaphroditic flowers.

Mexico, Colombia, Peru, and Surinam, according to Eyma.

Clusia lunanthera Maguire, sp. nov. Arbor terrestris; foliis petiolatis, laminis magnis, oblanceolatis vel oblanceolato-ellipticis, apicibus acutis vel abrupte acuminatis, chartaceis, nerviis prominentibus subtus, prominulis supra; inflorescentibus 1–3-floribus; floribus staminatis: sepalis 7 primis oppositis, sequentibus imbricatis, petalis 8, staminibus numerosis, antheris extrorsis subdistalibus, reniformibus, pseudo-capitatis, staminodis numerosis, anantheris, centralibus agglutinatis; floribus pistillatis; sepalis 7, petalis 8, staminodiis 2–3 seriatis diste clavatis, cupulatis; ovariis 8-locularibus, stigmatibus 8, umbraculiformibus; fructibus non visis.

Terrestrial, tree to 12 m. tall, 10 cm. diam.; latex copious, orange; branchlets slender, terete, internodes ca. 10 cm. long; petioles slender (2) 3–4 cm. long, blades 12–20 cm. long, oblanceolate to oblanceolate-elliptic. both base and apex acute, or the apex abruptly acuminate, chartaceous, midrib on the upper surface less conspicuous, slightly keeled toward the base, on the lower surface prominent and acutely keeled, primary veins ascending at 30°–40° angle, somewhat recurved upwards, collected in a peripheral vein 1 mm. or less from the margin, secondary veins somewhat less prominent, veination of upper surface less prominent than that of the lower; inflorescence 1–3-flowered, the peduncle 1.0–1.5 cm. long, pedicels equally long, primary bracts 8–10 mm. long, acutish, the secondary 6–8 mm. long, broadly obtuse; staminate flowers: sepals 7, the first two opposite, broadly lunate to semiorbicular, 6–10 cm. long, 14–16 mm. broad, the remainder more or less imbricate, broadly ovate-oblong, 14–18 mm. long, petals 8, obovate in general form, but variously and irregularly crimped, crenated, or lobed, 6–7 cm. long, stamens numerous, filaments more or less flattened and prismatic, particularly toward the base, crassulous, shortly connate, 6–10 mm. long, anthers extrorse, subdistal, inflexed, the anthers thus reniform, pseudo-capitate, dehiscing for their full length of 1.0–1.5 mm.; staminodia central, numerous, ca. 3 mm. long, distinct, prismatic, anantherous, strongly agglutinated; pistillate flower: sepals 7, similar to those of ♂ flowers; petals also similar but apparently only 4–5 cm. long;

92 Meded. Bot. Mus. Utrecht 4: 18. 1932.

93 Contr. U. S. Nat. Herb. 24: 14. 1922.

staminodia 4 mm. long, numerous, 2–3-seriate, flattened at the base, prismatic and clavate distally, connate for a fourth to half their length, forming a distinct cup; ovary 8-celled, ovules numerous, axial; stigmas 8, forming a massive, broad, umbraculiform body; mature fruit not seen, but probably flask-shaped, attaining 3 cm. in length.

TYPE: tree to 12 m. high, 15 cm. diam., latex orange, copious, petals totally white, the flower 8–10 cm. diam., frequent, high bush about rim of Arrowhead Basin, Tafelberg, *24422* ♂. New York Botanical Garden.

Known only from Tafelberg. The following additional collections may serve as cotypes: high bush about rim Arrowhead Basin, Tafelberg, *24428* ♀; leaves petioled, elliptic-oblanceolate, flowers and bracts totally white, fruit flask-shaped, frequent, east escarpment, 2 km. south of East Ridge, *24586* ♀; tree 10 m. tall, leaves large, elliptic-oblanceolate, petioled, flowers 8–10 cm. diam., immature fruit elongate, frequent, *Clusia* bush 1 km. east Savanna VIII, *24546* ♀. The extraordinary tovomitoid character of the stamens makes *C. lunanthera* unassignable to any of the recognized tribes of *Clusia*. The apical position of the anthers suggests *Tovomita*, but the central staminodial mass of the staminate flower, and the 8-locular ovary with numerous ovules, and indeed the entire general appearance is compellingly Clusioid.

Oedematopus quadratus Maguire, sp. nov. Arbuscula terrestris; ramulis valde quadrangulatis; foliis petiolatis, laminis late obovatis vel oblanceolatis, apicibus late obtusis vel aliquantum acutis, basibus cuneatis, coriaceis, aliquantum involutis, nerviis prominentibus subtus, prominulis supra; inflorescentibus campactis ferme 9–15-floribus; sepalis 4, decussatis, petalis 4, decussatis; floribus staminatis: staminibus 8, 2-seriatis; filamentis valde dilatis ad bases; floribus pistillatis: staminodiis (2) 4 cum antheris; ovariis 6-locularibus, ovulis numerosis; stigmatibus 6, peltatis, subsessilibus, lateraliter dispositis.

A much-branched, rounded shrub or tree to 5 m., rooting from lower limbs, branches sharply quadrangular through several years, glabrous, gray-brown; leaf blades (2) 5–10 cm. long, (2) 2.5–5.0 cm. wide, coriaceous, somewhat involute, broadly obovate to oblanceolate, the apex rounded or sometimes acutish, cuneate from above the middle to the 5–10-mm. long petiole; primary veins making 45° angle with midrib, inconspicuous above, moderately prominent beneath, latex tubes conspicuous beneath, reddish, ascending more sharply and intersecting lateral veins; inflorescence recurved, compact, usually compound, 9–15-flowered, with 1- or mostly 3-flowered terminal clusters, primary and secondary branches 2–15 mm. long, pale yellowish, sharply angled; bracts 2–3 pairs on the final branch, 1–2 mm. long, ovate, subacute, carinate, the keel strongly decurrent, base broadly connate, the ultimate bracts closely subtending the flowers; sepals 4, orbicular-ovate, cupped, the outer 4–5 mm. long, 3–4 mm. broad, thick, carinate, scarious margined, the inner pair 5–6 mm. long, 3–4 mm. broad, red latex tubes obvious, scarious, less fleshy and not carinate; petals 4, fleshy, white, 5–6 mm. long, 2–3 mm. wide, oblong, rounded, the margins scarious, bearing a broad, rounded axillary gland; stamens in the staminate flowers 8, in 2 cycles, the filaments 1.2 mm. long, abruptly constricted above, the dilated and thickened basal portion about 1 mm. long and 0.6 mm. wide, connate, gland-like, flattened on the inner surface, anthers 0.8 mm. long,

oblong, retuse, the cells dehiscing along the margins, the connective broad; staminodia of the pistillate flower (2) 4, 2 mm. long, the base broad, the anthers apparently usually abortive; ovary normally 6-celled with many ovules; stigmas normally 6, peltate, subsessile, laterally disposed, pentagonal, 1–2 mm. long.

TYPE: much-branched small tree, bracts red, petals white, leaves oblanceolate, 5–10 cm. long, common, Savanna II, Tafelberg, Surinam, August 6, 1944, *Maguire 24238* ♂. New York Botanical Garden. Cotypes: bushy, thickly-branched shrub or tree to 5 m., strongly rooting up to 1–2 m., common, Savanna I, Tafelberg, *24248* ♀; shrub to small rounded tree, fruit ca. 1 cm. long, subglobose, fleshy, common, Savanna I, Tafelberg, *24741;* a fourth collection, Savanna I, Tafelberg, *24247* ♀, has narrow, merely lanceolate leaves.

This species is one of the most common savanna shrubs on Tafelberg, and there is quite uniform in general characters. It is most similar to *O. duidae* Gleason from Mount Duida, Venezuela, but our species differs in the much coarser, quadrangular, glabrous stems, much larger leaves, (2) 4 rather than 8 staminodia or stamens in the pistillate flower, and the 6-celled rather than 4-celled ovary. *O. quadratus* is known only from Tafelberg.

HAVETIOPSIS FLAVIDA (Benth.) Pl. & Tr. BRITISH GUIANA: epiphytic shrub from crown of an *Eperua* in wallaba forest, leaves thinly leathery, flowers in terminal fascicles, creamy, Takutu Creek to Puruni River, Mazaruni River, *F2181* (*F.D. 4917*) ♀; woody epiphyte with whitish latex, fruit globose, ca. 1 cm. long, green, topped by 4 black stigmas, dehiscent into 4 cocci, white inside, seeds numerous, light brown, embedded in 4 masses of scarlet pulp, Kaituma River, Barima River, *F2470* (*F.D. 5206*) ♀. Identified by Mr. N. G. Sandwith. Widespread; Trinidad and Venezuela to Brazil and Bolivia.

QUAPOIA BRACTEOLATA Sandw. BRITISH GUIANA: vine, banks and swamps along Kamuni Creek, Groete Creek, Essequibo River, *22927*. Known only from British Guiana.

Not a single collection of *Tovomita* was made in Surinam, although evidently the genus is frequently encountered there. The excellent account of *Tovomita* in British Guiana by Sandwith[94] admits 10 species. Our collections likewise yield 10 species, 4 of them not accounted for by Sandwith, of which 2 are proposed as new.

TOVOMITA BRASILIENSIS (Mart.) Walp. BRITISH GUIANA: shrub to 1 m. high, buds pale green, flowers white, Amatuk Portage, Potaro River, *23550* ♂. New to British Guiana. Amazon Basin and French Guiana according to Engler. Our specimens seem to conform fairly satisfactorily with Brazilian material except for the essentially veinless leaves.

TOVOMITA BREVISTAMINEA Engelm. BRITISH GUIANA: tree 10 m. tall, 12 cm. diam., mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22897* ♀; creek side, Mazaruni Station, Mazaruni River, *F1276* ♀. British Guiana to Brazil.

TOVOMITA CALODICTYOS Sandw. BRITISH GUIANA: tree 10 m. tall, 12 cm. diam., mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22898* ♂; mixed forest, Kamuni Creek, Groete Creek, Essequibo River,

[94] Kew Bull. 1936: 210–221.

22898 ♀. Known only from British Guiana. Tree 20 feet tall with low stilt roots, thick yellow latex, scanty, mature fruit dark green, obovoid, 4-lobed, short-stipitate, 2.5–3.0 cm. long, 2 cm. broad, Kakaralli-Zizyphus forest on lateritic soil, Keriti Creek, Essequibo River, *F871*.

Pistillate material was not available when the original description[95] was drawn up. In neither of the fruiting collections cited above do flowers occur, but the character of the ♀ inflorescence and the fruit may here be noted: inflorescence 2–4 cm. long, apparently few- (5–12) flowered, pedicels becoming much thickened, 5–12 mm. long, hardly compressed; mature fruit broadly obovoid, 2.5–4.0 cm. long (inclusive of the styles), more or less 4-lobed, abruptly narrowed into a beak 5–8 mm. long, styles 4, ca. 1 mm. long, ovate, 1.0–1.5 mm. long, erect, free above the middle, the fruit explanately dehiscing at length into 4 valves, exposing the 4 oval seeds, 1.5–2.0 cm. long, embedded in a copious matrix.

TOVOMITA CEPHALOSTIGMA ? Vesque. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F1331*. Flowers immature. Uncertainly assigned to this species. Guiana.

Tovomita divaricata Maguire, sp. nov. Arbor; foliis petiolatis, laminis chartaceis, lanceolatis vel auguste ellipticis, basibus et apicibus acuminatis, nerviis primis 8–10 jugis, arcuatis; inflorescentibus rigidis divaricatis; alabastris maturis oblongis, sepalis exterioribus appendicibus latis instructis, compressis, naviculatis; sepalis 4, exterioribus naviculatis, interioribus lanceolatis, acutis; petalis 4, oblanceolato-obovatis; staminibus 25–30, gynaeceis omnino obsoletis; floribus pistillatis non visis.

Tree at least 15 m. high and 10 cm. diam., branchlets slender; petioles ca. 1.5 cm. long, slender, raised margins of the petiolar pit ca. 0.5 mm. high and ca. 1.5 mm. diam., blade thin, chartaceous when dry, lanceolate or narrowly elliptic, acuminate at base and apex, 10–17 cm. long, 3–5 cm. broad, 8–10 pairs of upwardly arcuate prominent primary veins, 10–15 mm. apart, running parallel to the margin past the next succeeding veins, their terminal branches anastamosing, but the primaries not collected in a marginal vein, secondary veins indefinite, more numerous, not reaching the margins or the terminal branches only doing so, veins on the upper surface prominulous only and much-branched, not distinguishable as primaries and secondaries; branches of the terminal inflorescence rigid, divaricate, peduncles 1–1.5 cm. long, coarse, clavate, secondary branches 1 cm. or less long, clavate, the pedicels 6–8 mm. long, not articulate with the flower, clavate; buds oblong, the body ovoid, the outer sepals prolonged into a broad flattened appendage, the whole ca. 1 cm. long, the appendage 4–5 mm. long; perianth members 8, more or less decussate, the outer two pairs sepaloid, the first ca. 11 mm. long, boat-shaped, minutely apiculate, the apex broadly and vertically compressed immediately below the apiculum, the interior sepals 8–10 mm. long, lanceolate, acute, petals 4, oblance-obovate, acute;

[95] Kew Bull. 1936: 219.

Explanation of figure 22

FIG. 22. *Tovomita divaricata* Maguire. *Fanshawe 742* ♂. 1, under surface of leaf, × ½; 2, inflorescence, × 1; 3, bud, × 3; 4, sepal, × 2; 5, stamen, × 10. *Tovomita Fanshawei* Maguire. *Fanshawe 1456* ♂. 6, under surface of leaf, × ½; 7, node showing curiously cupulate petiolar pits, × 1; 8, inflorescence, × 1; 9, bud, × 2; 10, stamen, × 10.

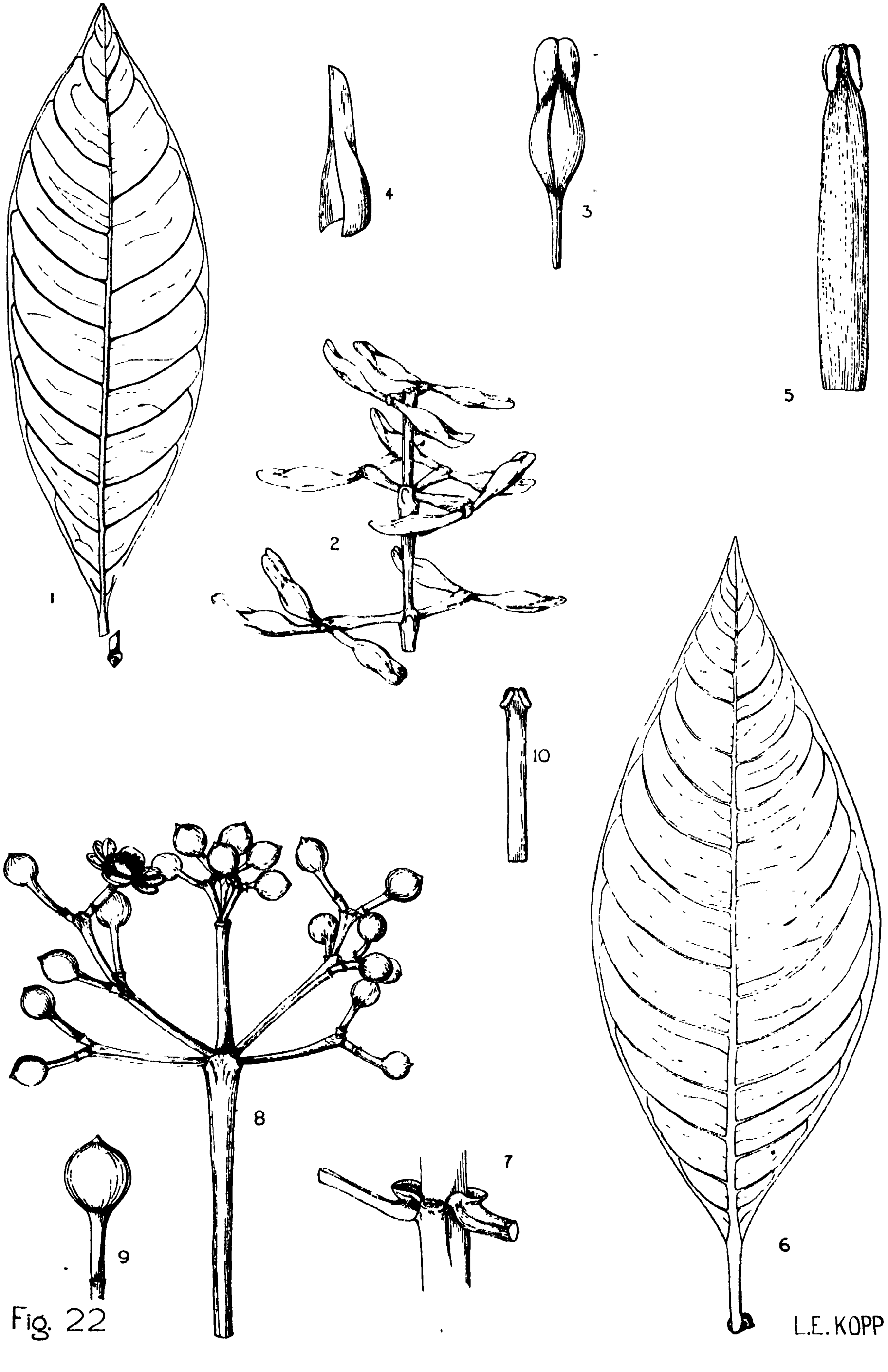

Fig. 22

stamens 25–30, the filaments 3–5 mm. long, linear, subcrassulus, obscurely prismatic, drying brown, anthers 0.5–0.75 mm. long, white; ovary totally obsolete; pistillate flower not seen.

TYPE: tree 50 feet high, 4 inches diameter, leaves soft and supple, flowers in terminal spikes, buds pale green, flattened, obcuneate, notched and channeled, flowers pale green, the two outer petals boat-shaped, from Kakaralli-Clump wallaba forest, on lateritic iron-stone soil, Mahdia Creek, Potaro River at 108 mile, Bartica-Potaro Road, British Guiana, *Fanshawe 742.*

Apparently there are no immediate relatives of this species known. It is unique in its divaricately branched inflorescence and naviculoid outer sepals.

Tovomita Fanshawei Maguire, sp. nov. Arbor; foliis petiolatis, laminis chartaceis, ellipticis, apicibus acuminatis, basibus acutis, nerviis primis 8–10 jugis valde arcuatis; alabastris maturis globosis, apiculatis; sepalis 6, 4–5 mm. longis, oblongo-orbiculatis, decussatis; petalis 4, 3–4 mm. longis, oblongo-orbiculatis, decussatis; staminibus numerosis filamentis linearibus, ca. 1.5 mm. longis, antheris ca. 0.4 mm. longis, albidis; floribus pistillatis et frunctibus non visis.

A stilt-rooted tree, reaching at least a height of 15 m. and a diameter of 20 cm.; petioles 2–3 cm. long, slender, the axillary pit with a conspicuously raised semiorbucular border 4 mm. in diameter, blade 15–22 cm. long, 6–9 cm. broad, elliptic, acute at the base, acuminate at the apex, chartaceous, primary veins 8–10 pairs, strongly arcuate upwards, not collected in a marginal nerve, usually secondary veins inconspicuous, short, more numerous, extending from ⅓ to ⅔ the distance to the margins; inflorescence terminal (in the type 3-peduncled), peduncles 3–4 cm. long, secondary branches ca. 2 cm. long, the ultimate articulate usually at the middle, or below at the minute bractioles, bracts and bractioles early caducous; buds spheroid, ca. 4 mm. long, apiculate; perianth members 10, decussate, the outer pair completely covering the bud, the two succeeding pairs sepaloid, oblong-orbicular, 4–5 mm. long, strongly concave, striate, the inner two pairs petaloid, subcrassulus, oblong-orbicular, 3–4 mm. long; stamens numerous, much exceeding 50, filaments slender, ca. 1.5 cm. long, drying brown, the outermost 0.5–0.75 mm. long, anthers ca. 0.4 mm. long, white; the pistillate flower not seen.

TYPE: tree 50 feet high, 8 inches diameter, stilt-rooted; leaves leathery, supple; male flowers in terminal inflorescence, pale green, perianth lobes concave, patent; stamens erect, anthers white, from Kakaralli-Clump wallaba forest, 107 mile, Bartica-Potaro Road, *Fanshawe 1456.* New York Botanical Garden.

T. Fanshawei obviously belongs in that loose assemblage of species with comparatively thin leaves, with the few veins strongly arcuate upwards. Because of its short stamens our species might be associated with *T. brevistaminea,* but this latter has more or less non-curved primary veins and 25 or fewer stamens with thick filaments. Or it may be associated with *T. Schomburgkii,* but that species has relatively inconspicuous petiolar pits, oblong, non-apiculate buds, 4 sepals, 4 oblong petals ca. 6 mm. long, filaments slender ca. 4 mm. long, drying black, anthers ca. 1 mm. long.

TOVOMITA GRATA Sandw. BRITISH GUIANA: tree 40 feet high, 10 inches

diameter, slightly fluted, with stilt roots, latex thick, yellow, buds green, conical, abruptly acuminate, calyx lobes lanceolate, green, corolla lobes oblong, hooded, reflexed, white, stamens numerous, white, Barabara Creek, Lower Essequibo River, *F948* ♂; calyx lobes pale green, reflexed, corolla lobes white, fleshy, reflexed, Groete Creek, Lower Essequibo River, *F1985* ♀. British Guiana.

TOVOMITA OBOVATA Engl. BRITISH GUIANA: tree to 70 feet high, 14 inches diameter, large stilt-roots to 7 feet high, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22948* ♀; latex thick, yellow, scanty, perianth pale green, concave, reflexed, stamens numerous, erect, white, Siba Creek, *F680* ♂; inflorescence terminal, in bifurcate cymes, rachis flattened, calyx pale green, reflexed, corolla translucent, whitish-green, reflexed, stamens erect, white, Groete Creek, Essequibo River, *F1995* ♂. British Guiana.

TOVOMITA SCHOMBURGKII Pl. & Tr. BRITISH GUIANA: tree 30 feet high, 4 inches diameter, leaves thinly leathery, flowers greenish-white, calyx and corolla reflexed, stamens white, erect, Moraballi Creek, Essequibo River, *F1323* ♂. Amazonian Brazil to British Guiana.

TOVOMITA TENUIFLORA Benth. BRITISH GUIANA: tree 40 feet high, 8 inches diameter, with stilt-roots, leaves leathery, venation obscure, buds conical, inflorescence sessile, or short-peduncled, rays compressed, flowers whitish-green, lobes pátent, convex, stamens erect, white, Bartica-Potaro Road, 107 mile, *F1451*. New for the Guianas, hitherto apparently known only from the type locality, "flumina Casiquiari," Venezuela.

RHEEDIA BENTHAMIANA Pl. & Tr. SURINAM: tree 12 m. tall, 15 cm. diam., with copious yellow latex, upper branches and shoots cauliflorus, montane forest, hill slope, km. 4.5, Saramacca River Headwaters, *24133*. Surinam, British Guiana.

RHEEDIA KAPPLERI Eyma. BRITISH GUIANA: tree 5 m. high, 6 cm. diam., leaves rigid brittle, fruit ovoid, green, tuberculate, Potaro River above Kaietêur Falls, *23373*; tree 30 feet high, 5 inches diameter, unbuttressed, latex yellow, cauliflorus, flower palest cream, calyx and corolla reflexed, stamens numerous, whitish on a conical disk, Siba Creek, *F662*. Unreported by this name from British Guiana. French Guiana, Surinam. Probably not distinct from *R. acuminata* Pl. & Tr. or *A. floribunda* (Miq.) Pl. & Tr., or possibly even *R. virens* Planch.

RHEEDIA LATERIFLORA L. BRITISH GUIANA: tree 50 feet tall, 6 inches diameter, latex thick, yellow, cauliflorous, calyx and corolla translucent, whitish, corolla lobes concave, reflexed stamens marginal on a raised disk, filaments whitish, *F595*. This collection, from a staminate tree, is quite adequately referable to *R. lateriflora* which hitherto has been known only from the West Indies from Jamaica to Trinidad.

RHEEDIA MACROPHYLLA (Mart.) Pl. & Tr. BRITISH GUIANA: tree 30 feet high, 3 inches diameter, secondary forest on lateritic gravelly soil, Mabaruma, Aruka River, N. W. D., *F2394*. Brazil and the Guianas.

Rheedia Martinii Maguire, sp. nov. Arbor; foliis petiolatis; laminis ellipticis vel oblongo-ellipticis, basibus rotundis, apicibus rotundis, late obtusis vel abrupte breviterque acutis, subcoriaceis; nerviis supra et subtus aequalibus prominentibus, primis 15–18 jugis; floribus numerosis fasciculatis, pulvinis axillaribus; pedicellis subcapillaribus; sepals 2, oppositis, subconnatis, petalis 4, decussatis, vel 5–7, imbricatis, late obovatis; stamini-

bus ± 20, filamentis lineari-subulatis subcrassulis, antheris distalibus, subglobosis; floribus pistillatis et fructibus non visis.

Tree at least to 12 m. high and 25 cm. diam.; latex copious, yellow; branchlets green, sharply angled; petiole 1.0–1.5 cm. long, the petiolar pit with raised margin, densely cartilaginous within, blades 6–8 cm. long, 3–5 cm. broad, elliptic to oblong-elliptic, the base rounded, the apex rounded, broadly obtuse, or abruptly short acutish, terminating in an inconspicuous callosity, thickly chartaceous, drying yellowish-green, veins nearly equally prominent on both surfaces, the primary veins 15–18, usually branching beyond the middle, collected in a marginal nerve, the secondary considerably less prominent, not reaching the margin; flowers numerous, fascicled, the pulvini axillary, persistent and enlarging through a number of years; pedicels 1.5–2.0 cm. long, slender, sepals 2, 1.5–2.0 mm. long, broadly obovate, ca. 5 mm. long; stamens 20 ±, filaments linear-subulate, subcrassulus, 4–5 mm. long, narrowed somewhat upwards, anthers completely distal, subglobose, dehiscing lengthwise, ca. 0.5 mm. long, rudimentary pistil massive. Ovary and fruit unknown.

TYPE: tree 12 m. high, 15 cm. diameter, yellow latex copious, flowers whitish, petals reflexed, high bush, south rim Arrowhead Basin, Tafelberg, Surinam, August 20, 1944, *Maguire 24427*. New York Botanical Garden.

Since the fruit is lacking it is impossible definitely to refer *R. Martinii* to any section. However, because of ramular and foliar similarities, it is not improbable that affinities lies with *R. floribunda*, *R. virens*, and *R. Kappleri*, thus with the section *Verticillaria*. If this be correct, then the fruit will be found to be tuberculate.

I take pleasure in naming this fine tree in honor of my good friend, Thomas W. Martin, industrialist, scientist, and humanitarian.

PLATONIA INSIGNIS Mart. SURINAM: tree 25 m. tall, 50 cm. diameter, petals cream, peach-colored within, deep pink without, frequent, high mixed wallaba forest, below talus north base Tafelberg, *24842*. Brazil to the Guianas.

MORONOBEA JENMANI Engl. BRITISH GUIANA: tree 5 m. tall, 15 cm. diameter, leaves crowded toward branch ends, bush islands, Kaieteur Savanna, *23442*, topotype. Apparently known only from the type locality.

SYMPHONIA GLOBULIFERA L. f. BRITISH GUIANA: tree 70 feet high, 16 inches diameter, stilt-rooted, latex pale yellow, mixed forest, Takutu Creek, Puruni River, Mazaruni River, *F2122*. SURINAM: buttressed tree 25 m. tall, 7 dm. diameter, latex yellow, buds red, petals, column, and anthers red, stigmas white, frequent, pina swamps, 1.5 km. southwest of Base Camp (1), *24119;* tree 20 m. tall, flowers red, infrequent, border Savanna I, Tafelberg, *24360*. Highly variable and widely distributed in tropical Central and South America, and the West Indies; also in Africa.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 75, No. 4, pp. 439–445 JULY, 1948

TORREYA

The Seacoast Angelica in the Local Area. Although current manuals like Britton & Brown's *Illustrated flora* and the seventh edition of *Gray's Manual* give the southern limit of distribution for the seacoast angelica (*Coelopleurum actaeifolium*) in eastern North America as Massachusetts, and Norman Taylor does not list it at all in his classic "Flora of the vicinity of New York," the species is now known from at least three stations in our area. Credit for its discovery in our area seems to be due to A. W. Evans, who found it in thickets near the beach on Fisher's Island, Suffolk County, Long Island, in July, 1916. Next Roy Latham found a colony of several hundred plants at East Marion, Suffolk County, on July 10, 1921. W. C. Ferguson's no. 4062 was collected on dry hills near the Sound, also at East Marion, on July 13, 1924. Most recently the species has been collected in the upland border of a tidal marsh at the Barn Island Game Management Area near Stonington, Stonington Township, New London County, Connecticut. This collection was made by W. R. Miller and F. E. Egler on August 10, 1947, and is represented by their no. 47–46. Specimens of this and the previously mentioned collections are all on deposit in the Local Herbarium at the New York Botanical Garden.—H. N. MOLDENKE.

Metasequoia Summary.[1] The genus *Metasequoia* is a conifer which was widely distributed over the northern hemisphere in past ages. Its fossil remains (wood, leaves, cones) have been found in Alaska, Greenland, Spitzbergen and northern Siberia, in rocks of Eocene age (60,000,000 years old); in rocks of Miocene age (30,000,000 years old) in Oregon and California, Germany and Switzerland, Manchuria and Japan. It was considered to have become extinct some 20,000,000 years ago, since its fossil remains did not occur in rocks younger than Miocene.

About two years ago reports came from China of the discovery of three trees of *Metasequoia* in a village in the interior. One of these living trees was described as large; no photographs were available, nor was it possible to find out much about it. In order to establish the accuracy of this report, and to learn the true nature of these trees, Ralph W. Chaney, paleobotanist of the University of California and the Carnegie Institution of Washington, and Milton Silverman, Science Editor of the San Francisco "Chronicle," left San Francisco by Pan American World Airway plane in February, bound for Shanghai and Chungking: from this former capital of China, they proceeded down the Yangtse on a riverboat to Wan Hsien. Here they secured baggage porters and sedan chairs, and set out on a journey southward more than a hundred miles into the provinces of Szechuan and Hupeh. Traveling over a path largely made up of a rock slab stairway, they covered from 20 to 30 miles a day in rain and fog—a path which crossed four mountain ranges of which two were over 5,000 feet high. This is a region seldom visited by foreigners—in fact, the remote village at the end of the journey had never before been entered by a foreign visitor. The reported presence of hundreds of bandits made necessary extreme precautions to prevent theft of cameras and other essential equipment; an armed guard was necessary during most of the journey.

"Just outside the village of Mo-tao-chi, 70 miles south of Wan Hsien," says Dr. Ralph W. Chaney, "we came upon the first trees of *Metasequoia*. The largest is

[1] Based on a statement by Dr. Ralph W. Chaney, Professor of Paleontology, University of California, Berkeley; Chairman, Save-the-Redwoods League's Education and Interpretation Committee.

nearly 100 feet tall, and 68 inches in diameter above the buttress (almost 11 feet in diameter where the buttress flares out at ground level). It has large branches which extend upward instead of turning downward as in the living redwood; another difference is that *Metasequoia* sheds its leaves in winter, so it was bare at the time of our visit; its bark has a reddish tone suggestive of the redwood, but is much thinner than that of the American tree. These and other differences readily distinguish *Metasequoia* from *Sequoia*, but a relationship between the two trees is at once apparent from the similarity of their cones, and their wood is also much the same. Preliminary examination indicates that *Metasequoia* may represent the ancestor of the American *Sequoia*.

''Continuing southward some 35 miles, we came into a valley occupied by over a hundred trees of *Metasequoia*. While none of these is as large as the giant tree at Mo-tao-chi, they are growing on slopes which have not been fully logged off, as is the case farther north. Here we are able to study the dawn redwood (*Metasequoia*) under essentially native conditions. It grows best besides streams or elsewhere in wet soil; it is not found at elevations far above 4,000 feet, for it appears to require mild winter temperature. Its associates in the forest are chestnut, sweet gum, oak, and birch, all of which trees grow today in many parts of the United States. In addition, there lives with *Metasequoia* a large tree known as katsura which is confined to northeastern Asia at present. All these associates of the living *Metasequoia* had ancestral species growing with the fossil *Metasequoia* in western North America and Europe during the geologic past. Here we have a segment of yesterday—a forest which has miraculously survived destruction for a score of million years.

''How much longer will *Metasequoia* continue to exist in this central Asian sanctuary? An answer to the question is difficult to give, for in this land of fuel and timber shortage, these great trees of the past are rapidly being cut down by Chinese farmers. Some steps must be taken at once if *Metasequoia* is to be saved from extinction during our lifetime, if it is to continue to live on earth as one of the oldest, if not the most ancient forest tree in existence. At some time in the near future, an announcement will be made of the plans being made to preserve the *Metasequoia* of Tiger Valley from destruction.''

Dr. Chaney and Dr. Silverman have recently returned to California with specimens of the wood bark, leaves and cones of these remarkable trees, and with many scientific data which may be expected to aid in solving some of the problems surrounding the age-long survival of these Chinese ancestors of the California and Oregon redwood.

PROCEEDINGS OF THE CLUB

Minutes of the Annual Meeting, January 8, 1948. The Annual Dinner Meeting was held in the Faculty Dining Room of Hunter College. There were 82 members and friends present. Following the dinner, the regular annual business meeting was conducted by President Shull.

The minutes of the preceding meeting were approved as read.

Twenty-six persons were unanimously elected to Annual membership.

The report of his activities as Business Manager of the club was given by Dr. Clum.

Dr. Lawton, the Treasurer, then gave the report of the total membership of the club and the statements of the Endowment Funds and General Fund of the club.

Dr. Levine then spoke briefly of the work of the Membership Committee.

The Chairman of the Field Committee, Dr. Small, reported on the activities of the Field Committee in conducting field trips and compiling lists of plants.

Dr. Rickett, Editor of the Bulletin, reported briefly on the progress of publishing the Bulletin.

Dr. Matzke, representative of the club in the New York Academy of Sciences, gave a short report of that organization's activities as did Dr. Avery who represents the club at the AAAS.

Dr. Shull, as retiring President of the Club, then spoke to the meeting on the subject, ''What Is Heterosis?''

Following the presentation of this paper, Dr. Simpson, Corresponding Secretary, reported the results of the election. The newly elected officers are as follows:

President—John A. Small
1st Vice-President—George S. Avery Jr.
2nd Vice-President—Wendell H. Camp
Corresponding Secretary—Jennie L. S. Simpson
Recording Secretary—Donald P. Rogers
Treasurer—Elva Lawton
Editor—Harold W. Rickett
Business Manager—Harold H. Clum
Bibliographer—Lazella Schwarten
Representative on Board of Managers of N. Y. Botanical Garden—Fred J. Seaver
Delegate to Council of the N. Y. Academy of Sciences—Edwin B. Matzke
Representatives on Council of A.A.A.S.—John S. Karling, P. W. Zimmerman
Members of the Council—Frederick Kavanagh, A. E. Hitchock, S. F. Trelease, E. H. Fulling

At the suggestion of Dr. Camp, the motion was made and passed that the Torrey Botanical Club unanimously elect these officers as chosen by ballot.

The meeting was then adjourned to a lecture room, where Mr. Rutherford Platt gave a talk on "North Pole Wild Flowers," illustrated with Kodachrome pictures.

The meeting adjourned at 10:20 P.M.

Respectfully submitted,
Honor Hollinghurst,
Acting Recording Secretary

Minutes of the Meeting of January 21, 1948. The meeting, at Columbia University, was called to order at 8: 05 p.m. by President Small. Twenty members were present. The minutes of the preceding meeting were read and approved.

Dr. Lela V. Barton of the Boyce Thompson Institute spoke to the club. Her abstract of the address follows:

The Effect of Age and Storage Conditions of Seeds Upon Germination and Yield. Seeds showed differential water absorption according to species. In the order of increasing water-absorption capacity at relative humidities of 35, 55, and 76 per cent, the seeds studied were peanut, lettuce, flax, pine, tomato, and onion. This order persisted regardless of storage temperatures or atmospheric humidity. With a relative humidity of 35 per cent, seeds took up approximately the same amount of water at 5° and 10° C but, in every case, less water was absorbed at the higher temperatures of 20° and 30° C. At 55 and 76 per cent relative humidities, however, the peak of moisture absorption was at 10° C and the lowest absorption at 30° C.

Comparisons of curves showed no direct relation of actual amount of water absorbed to germinability. However, it was found that seeds of high initial vitality were much more resistant to unfavorable storage humidities and temperatures than were those with low initial vitality. This fact was also demonstrated in a test using 8-year-old seeds of eggplant, onion, and tomato selected to give a range in viability. It was shown that deterioriation of a seed lot, once initiated, proceeds rapidly to the death of all the seeds under unfavorable storage conditions.

Moisture determinations made on seeds of carrot, eggplant, lettuce, tomato, and long-leaved pine, which were stored open in the laboratory, showed the moisture content in August approximately double that in January or Febuary. It is believed that these fluctuations contribute to deterioriation of seeds in open storage.

Seeds of various ages were used to determine the effect of age and storage

conditions on the yield of plants grown from them. Aster, verbena, pepper, tomato, and lettuce were tested. Plants from different seed lots of each variety were arranged in field plantings, the data from which could be analyzed statistically.

Results showed that old and fresh seeds of verbena and pepper produced plants of similar quality. Plants grown from 9-year-old seeds of aster flowered earlier than those from fresh seeds but produced the same total number of flowers during the growing season. Lettuce seed stored for 13 years produced heads of larger weight than fresh lettuce seeds. Tomato seeds, stored 13 years at room temperature and showing a germination capacity of only 6 per cent, produced plants which were inferior in field performance. However, tomato plants from seeds stored 13 years under dry conditions at $-5°$ C were equal in every respect to those from fresh seeds. Storage condition rather than age of the tomato seed was thus shown to have an effect on seedlings.

The meeting was adjourned at 9: 15.

Respectfully submitted,
DONALD P. ROGERS,
Recording Secretary

Minutes of the Meeting of February 3, 1948. The meeting, at Columbia University, was called to order at 8:05 p.m. by President Small. Twenty-five members and friends were present. No business was transacted. Dr. Donald P. Rogers of The New York Botanical Garden addressed the club on the subject, "A Comparison of Evolutionary Tendencies in Plants, Fungi, and Animals." His abstract of the paper folllows:

Of the several groups of organisms that have developed along independent and divergent lines from the generalized flagellate stock which is ancestral to nearly all higher forms, only three have progressed far enough to include well adapted and characteristic amphibious and terrestrial members. One such group is the Chlorophyta, so circumscribed as to include both Chlorophyceae and Archegoniatae, and for simplicity referred to as plants. A second is the Fungi, composed of Myxo-, Phyco-, Asco-, and Basidiomycetes, of which the Myxomycetes, as an aberrant group early split off from the main stock, are not further considered here. The third group may be called Animalia, and includes the Metazoa and those Protozoa considered to lie in their ancestral line.

These three groups in evolving through successive stages of life in water, between water and land, and on land have produced characteristic and different adaptations to similar environmental factors, or, figuratively, have solved similar problems by dissimilar devices. Omitting such aberrant and exceptional forms as may be supposed to be end-forms, lying outside the main lines of evolution of the group, one may summarize these adaptations and compare those of the three groups.

For restriction of water-loss in terrestrial organisms: plants, cutin (secretion of living cells) or cork (tissue of relatively impervious dead cells); animals, chitin (secretion) or stratum corneum (tissue); fungi, escape (inclusion of hyphae within substratum) or some protoplasmic control.

For reproduction without nuclear fusion: plants, zoospores and later tetraspores; animals, rare and insignificant (except for apogamous races); fungi, zoospores followed in succession by encysted zoospores, mobile zoosporangia, zoosporangia modified as true conidia, and specialized abstricted somatic cells (conidia).

For nutrition: plants, photosynthesis; animals, cytophagy or mass ingestion; fungi, diffusion only, often preceded by secretion of exoenzymes.

For an extensive generation of cells with a double chromosome complement: plants, by gradual extension of diploid and reduction of haploid, both being retained as distinct generations; animals, sudden and very early loss of haploid as a generation, and subsequent elaboration of diploid; fungi, interpolation of an increasingly extensive dikaryotic phase between the haploid thallus and the one-celled diploid phase, and gradual reduction of the haploid.

For increased certainty of association of gametes: plants, reduction of microgametophyte and motility of microspore; animals, copulatory apparatus;

fungi, loss of motility of both gametes, associated with gametangiogamy and somatogamy.

The contrasts evident in such a tabulation are evidence for the propriety of maintaining the three groups as mutually distinct.

The meeting adjourned at 9:10.

Respectfully submitted,
DONALD P. ROGERS,
Recording Secretary

Minutes of the Meeting of February 18, 1948. The meeting, at Fordham University, was called to order at 4:00 p.m. by President Small; 56 members and friends were present. The minutes of the two preceding meetings were read and approved. Dr. Charles A. Berger spoke on "Normal and Induced Polyploidation." His abstract of the address follows:

A new case of naturally occurring polyploidy in the development of a diploid plant has been found in the Silk Tree, *Albizzia julibrissin.* The diploid chromosome number of this species is 26. In seedling roots from 3 to 4 mm. in length tetraploid divisions are found in the large cells of the periblem. In roots less than 3 mm. in length no tetraploid and few diploid divisions are found. In roots longer than 5 mm. no polyploid mitoses were observed. All the tetraploid divisions showed paired chromosomes in prophase and metaphase, indicating that only one mitotic division of the 4*n* cells occurs from the time of their formation to the time of their differentiation. Mitotic activity in the tetraploid cells of this region is thus restricted to a very short period in the development of the plant. It seems probable that the tetraploid condition arises by a double chromosome reproduction in certain large cells as the last step in the embryology of the plant and that these cells divide only once during germination. A comparison of this case with similar cases found in *Allium cepa* and in *Mimosa pudica* was made and the difference between these three cases and the phenomenon of polysomaty found in *Spinacia oleracea* was pointed out. An account of the effects on mitosis of treatment with naphthalene acetic acid and some other chemicals was also presented.

The meeting was adjourned at 4:55.

Respectfully submitted,
DONALD P. ROGERS,
Recording Secretary

Minutes of the Meeting of March 2, 1948. The meeting was called to order by President Small at 8:20 p.m. at Columbia University; 77 members and friends were present. Three persons were elected to honorary life membership in the Club, seventeen to annual membership, and one to associate membership. The resignations of eight members were accepted with regret. Dr. Paul C. Mangelsdorf, of Harvard University, spoke to the Club on "The Origin and Evolution of Indian Corn." His abstract of the address follows.

In 1939 as the result of genetic and cytological studies on maize and its relatives, Mangelsdorf and Reeves developed a tripartite hypothesis to explain the origin of maize. They postulated: (1) that cultivated maize originated from a wild form of pod corn which was once, and perhaps still is, indigenous to the lowlands of South America; (2) that teosinte, the closest relative of maize is a recent product of the natural hybridization of *Zea* and *Tripsacum* which occurred after cultivated maize had been introduced by man into Central America; (3) that new types of maize originating directly or indirectly from this cross and exhibiting admixture with *Tripsacum* comprise the majority of Central and North American varieties.

The three parts of this hypothesis have furnished the basis for recent research. In the case of pod corn, one of the important eighteenth century historical references has been experimentally verified. A weak allele of pod corn has appeared and it has been found that similar forms of weak pod corn are characteristic not only of prehistoric varieties but of many varieties in South and Central America. This new evidence, coupled with the fact that pod corn has

all of the morphological characteristics which one would expect to find in a wild progenitor of maize, make it highly probable that pod corn has been involved in some way in the ancestry of maize. The genetic nature of teosinte is now more clear than it was a decade ago. On the one hand, the genetic differences between teosinte and maize are much too great to sustain any hypothesis that maize has originated from teosinte by a few large-scale mutations. On the other hand, the nature of the genetic differences between teosinte and maize almost precludes the possibility that teosinte is a good wild species. Teosinte differs from maize primarily by four blocks of genes located on chromosomes 1, 3, 4, and 9.

The conclusion that new varieties of maize came into existence in Central America as the result of hybridization between maize and *Tripsacum* receives new support from the recent evidence. In western Guatemala where both *Tripsacum* and teosinte grow in profusion, there occurs a great diversity in maize varieties, and two extreme types, one similar to the maize of South America and the other exhibiting characteristics of *Tripsacum*, are found. A study of the internal genetic characteristics of maize varieties from all parts of America also shows reasonably consistent patterns. Intermediate alleles of pod corn, for example, have their highest frequency in Paraguay and Bolivia and their lowest in the American Corn Belt. Similar patterns are found for the distribution of the inhibitor factor on chromosome 9 and for modifying factors affecting the development of secondary pistillate florets. Finally, it is evident that recent evolutionary trends in the differentiation of cultivated maize involve hybridization and introgression between tripsacoid and non-tripsacoid varieties.

The meeting was adjourned at 9:30 p.m.

Respectfully submitted,
DONALD P. ROGERS,
Recording Secretary

Minutes of the Meeting of March 17, 1948. The meeting was called to order at 8:45 p.m. by President Small at Hunter College; 20 members and friends were present. The minutes of the two preceding meetings were read and approved. The auditing committee reported that the accounts of the Club for 1947 were correct. Dr. Richard A. Howard, of the New York Botanical Garden, spoke on the subject "Following Ekman's Footsteps in Santo Domingo." His abstract of the address follows:

The Swedish botanist Erik Leonard Ekman was one of the outstanding botanical collectors of the past century. His early work was in South America but his most important work was done in Cuba and Hispaniola. Supported by grants from the Swedish Academy of Science, Ekman collected in Cuba and Hispaniola almost continuously from 1914 until his death in 1931. The specimens he collected were sent to Urban for determination and formed a great part of material for Urban's series of publications entitled "Symbolae Antillanae" and "Plantae Haitienses et Domingenses Novae vel Rariores."

Ekman scorned the usual precautions of health and safety and lived with and as the natives of the area. He collected over all of Cuba and nearly all of the island of Hispaniola. From these collections Urban described over 2000 new species of flowering plants.

During a trip to the Dominican Republic in 1946 the speaker was able to follow a few of Ekman's routes and to re-collect several areas Ekman visited. Most important of these areas were the limestone mountain mass known as the Sierra de Bahoruco with a vegetation similar to the Morne de la Selle; the Enriquillo valley from Barahona to the shore of Lake Enriquillo now 150 feet below sea level; the Cordillera Central particularly the seepage swamp called Sabana Nueva where many species with Andean affinities occur, such as species of *Agrimonia*, *Viola*, *Sisyrinchium*, *Rubus*, *Potentilla*, and *Drosera*; and the Seibo savannah lands with numerous small lakes near Bayaguana and Guerra. During these travels the speaker encountered many people who remembered Ekman or had travelled with him. A large collection of anecdotes forming a character sketch of Ekman was obtained from those who knew him.

Ekman died in the Dominican Republic of pneumonia contracted on a wet January night spent without shelter in the mountains. He was buried in the

ground but his body was later placed in an unmarked grave in the Tomb of the Teachers in Santiago, Dominican Republic. A project has been started to place on Ekman's tomb a marker contributed by interested American botanists.

The meeting adjourned at 10: 00 p.m.

Respectfully submitted,
DONALD P. ROGERS,
Recording Secretary

REVIEW

Transactions of the British Bryological Society. Edited by F. A. Sowter. Volume 1, part 1, 64 pages, 5 textfigures. Cambridge University Press, Cambridge, England; 12s. 6d. net. [1947].

The British Bryological Society was organized in 1922 to continue the activities of the Moss Exchange Club, founded in 1896. The 27 Annual Reports of the Moss Exchange Club and the 20 Reports (Volumes I–IV) of the British Bryological Society are filled with valuable botanical information. Unfortunately for non-British bryologists, they were published not for general distribution, but only for a restricted membership. As a consequence, the many useful notes on geographic distribution of bryophytes, the short original papers, and the critical reviews to be found in these reports are not generally available for reference and have commonly been overlooked entirely in this country. The *Transactions,* however, are available to non-members of the British Bryological Society and to libraries in general, so that they will undoubtedly find a wide circulation outside of Great Britain.

The editorial policy of the *Transactions* is stated as follows: "Bryological contributions of all kinds will be welcomed and, as far as space permits, articles on non-British bryophytes will be included, but preference will be given to papers on British bryophytes or of special interest to British bryologists." The plan of publication of the *Transactions* is that a single part will appear each year, and five parts will form one volume, a system carried over from the *Reports* that preceded them. A curious feature of this first part of a new bryological journal is that it bears neither date of printing nor of issue, although from internal evidence one may gather that it was published during or after 1946. The first part reached us in September, 1947, presumably fairly promptly after its publication.

The first part of the *Transactions* contains three original papers by P. W. Richards, two by E. W. Jones, and one each by Grace Wigglesworth and E. F. Warburg. Several shorter articles by different contributors are gathered together under the collective title "Bryological Notes." The greater proportion of this issue is taken up with "New Vice-County Records," "Recent Bryological Literature," "Book Reviews," "Obituaries," and "Proceedings," all of special interest to British Bryologists.

The British Bryological Society may well be proud of its greatly enlarged and improved successor to the *Reports,* because of its useful and well-selected contents, its careful editing, and the technical excellence of its manufacture. Bryologists of all countries will look forward to the successful continuation of the *Transactions.*—W. C. STEERE.

LIST OF MEMBERS OF THE TORREY BOTANICAL CLUB

REVISED TO MARCH 2, 1948*

compiled by

ELVA LAWTON

LIFE MEMBERS

Baldwin, J. T., College of William & Mary, Williamsburg, Virginia	1945
Barnhart, John Hendley, The New York Botanical Garden, New York 58, N. Y.	1891
Bartram, E. B., Bushkill, Pike Co., Pa.	1908
Bessey, Ernst A., Michigan State College, East Lansing, Michigan	1907
Bray, William L., Syracuse University, Syracuse, New York	1908
Broadhurst, Jean, Teacher's College, Columbia University, New York, N. Y.	1906
Eames, Edwin H., 540 State St., Bridgeport, Conn.	1896
Evans, Alexander W., Dept. of Botany, Yale University, New Haven, Conn.	1896
Foxworthy, F. W., 762 Arlington Ave., Berkeley, Calif.	1906
Gleason, H. A., The New York Botanical Garden, New York 58, N. Y.	1906
Harper, Roland M., University, Alabama	1903
Haynes, Caroline C., Portland Road, Highlands, Monmouth Co., New Jersey	1901
Hepburn, Amy L., Schermerhorn Hall, Columbia University, New York, N. Y.	Ex-officio
Huntington, Archer M., 1 East 89th St., New York, N. Y.	1940
Jelliffe, S. Ely, Journal of Nervous & Mental Diseases, 70 Pine St., New York, N. Y.	1887
Kern, Frank D., Dept. of Botany, Pennsylvania State College, State College, Pa.	1908
Klein, Edward N. E., 3511 162nd St., Flushing, L. I., N. Y.	1908
Kupfer, Elsie M., Box 252 Chappaqua, New York	1901
Long, Bayard, 250 Ashbourne Road, Elkins Park, Philadelphia 11, Pa.	1906
MacDougal, D. T., R.F.D. 170, Carmel, California	1900
McKee, Arabella, Buena Vista Drive, Lake Alfred, Florida	1927
Marble, Delia W., Germantown, New York	1892
Peckham, Mrs. Wheeler H., Eagle Valley Road, Sloatsburg, Rockland Co., New York	1924
Polunin, Nicholas, McGill University Faculty Club, 3450 McTavish St., Montreal, P. Q., Canada	1947
Pretz, Harold W., 123 South 17th St., Allentown, Pa.	1906
Rosenberg, Rosalie, c/o M. E. Opton, 32 East 64th St., New York, N. Y.	1899
Shull, G. H., 60 Jefferson Road, Princeton, N. J.	1906
Taylor, Norman, 10 Rockefeller Plaza, New York, N. Y.	1905
Weatherby, C. A., Gray Herbarium, Harvard University, Cambridge 38, Mass.	1906

SUSTAINING MEMBER

Desmond, Thomas C., Box 670, Newburgh, New York	1942

ACTIVE MEMBERS

Aaron, Isador M., c/o A. Faulk, R.D. 1, Butler, Pa.	1947
Abe, Susie, 604 Oak St., Pullman, Washington	1948
Adams, Joseph E., P.O. Box 333, Chapel Hill, N. C.	1930
Adamson, Robert S., The University, Capetown, Union of South Africa	1940
Adolph, Raymond, 44 Roe Park, Highland Falls, N. Y.	1927

* The year opposite each name is that of the beginning of continuous membership. The years of life members are those of first election to the Club.

Agatha, Sister M., Immaculate Heart College, 2021 North Western Avenue, Los Angeles 27, Calif. 1943
Ahles, Harry, 1321 Herschell St., New York 61, N. Y. 1948
Ajello, Libero, 183 Weequaic Ave., Newark, N. J. 1941
Alexopoulos, Const. J., Dept. of Botany and Plant Pathology, Michigan State College, East Lansing, Mich. 1941
Allen, Mrs. Rhesa M. Jr., Box 609, Bluefield, W. Va. 1944
Allis, J. Ashton, Grace National Bank, 7 Hanover Square, N. Y., N. Y. 1927
Ames, Lawrence M., Materials Branch, The Engineer Board, Fort Belvoir, Va. 1937
Ames, Oakes, Botanical Museum, Oxford St., Cambridge, Mass. 1926
Anderson, Carrolle E., Sweet Briar College, Sweet Briar, Va. 1940
Anderson, J. P., Botany Dept., Iowa State College, Ames, Iowa 1935
Andrews, Henry N., Jr., Missouri Botanical Garden, St. Louis, Mo. 1937
Annan, Ormsby, 213 E. Superior St., Chicago 11, Ill. 1948
Antikajian, Grace, 2741 Sedgwick Ave., N. Y. 63, N. Y. 1945
Arnason, Thomas J., Biology Dept., University of Saskatchewan, Sask., Canada. 1945
Arnold, Chester A., Dept. of Botany, University of Michigan, Ann Arbor, Mich. 1943
Arteaga, Olga, Apartado 41, Cumana Edo. Sucre, Venezuela, S. A. 1946
Arthur, John M., Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1922
Atkins, Fred C., Yaxley Siding, Yaxley, Petersborough, England 1948
Avery, George S., Jr., Brooklyn Botanic Garden, Brooklyn 25, N. Y. 1933
Backus, Myron P., Dept. of Botany, University of Wisconsin, Madison, Wis. 1933
Bacon, Franklin J., Western Reserve University, Cleveland, Ohio 1940
Bailey, Irving W., Biological Laboratories, Harvard University, Cambridge, Mass. 1940
Baker, Woolford B., Emory University, Ga. 1942
Ballard, Charles W., College of Pharmacy, Columbia University, New York 27, N. Y. 1928
Barkley, F. A., Sección de Botanica, Facultad Nacional de Agronomía, Medellen, Colombia, S. A. 1946
Barnes, Mrs. Albert C., Montgomery Co., Merion, Pa. 1941
Barrett, Mary F., 41 Gates Ave., Montclair, N. J. 1929
Barrows, Florence L., Wheaton College, Norton, Mass. 1932
Bartlett, H. H., Dept. of Botany, University of Michigan, Ann Arbor, Mich. 1945
Barton, Lela V., Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1927
Bartsch, Alfred F., 2127 University Ave., Madison, Wis. 1946
Beals, A. T., 274 Summit Ave., Hackensack, N. J. 1946
Beard, Stanley D., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. 1943
Beck, William A., University of Dayton, Dayton, Ohio 1942
Bell, Hugh P., Botanical Laboratories, Dalhousie University, Halifax, Nova Scotia 1943
Benedict, Ralph C., 1819 Dorchester Road, Brooklyn 26, N. Y. 1910
Benitez, Garcia Carlos R., Dept. of Biology, University of Puerto Rico, Rio Piedras, Puerto Rico 1941
Benson, Lyman, Pomona College, Claremont, Calif. 1937
Berger, Charles A., Biological Laboratory, Fordham University, New York 58, N. Y. 1941
Berkman, Anton H., College of Mines, El Paso, Texas 1940
Billington, Cecil, 21060 Thirteen Mile Road, Birmingham, Mich. 1918
Black, L. M., Brooklyn Botanic Garden, 1000 Washington Ave., Brooklyn, N. Y. 1947
Blakeslee, A. F., Dept. of Botany, Smith College, Northampton, Mass. 1916
Bloch, Robert, Osborn Botanical Laboratory, Yale University, New Haven, Conn. 1940
Boke, Norman, Faculty Exchange, Norman, Oklahoma 1948
Bold, Harold C., Box 80, Vanderbilt University, Nashville, Tenn. 1928
Bonisteel, William J., Pine Plains, N. Y. 1923
Bonner, James, California Institute of Technology, Pasadena, Calif. 1940

Boughton, Gladys, 374 Washington Ave., Brooklyn, N. Y. 1942
Bowers, Clement G., Maine, N. Y. 1928
Bowler, Fairchild, 49 E. 86th St., New York, N. Y. 1941
Brenckle, J. F., Mellette, South Dakota 1940
Brown, Clair A., 1180 Stanford Ave., Baton Rouge 15, La. 1935
Brown, Donald M., Washington Missionary College, Takoma Park 12, Md. 1947
Brunel, Jules, Botanical Institute, 4101 Sherbrooke East, Montreal 36, Canada 1948
Buchholz, John T., c/o Mrs. Davis Turnbull, Monmouth, Ill. 1940
Buell, Katherine M., Doane College, Crete, Neb. 1948
Buell, Murray F., Dept. of Botany, Rutgers University, New Brunswick, N. J. 1947
Burlingham, Gertrude S., Newfane, Vermont 1910
Burton, Daniel F., Box 1568, State College, Miss. 1948
Byrnes, Garrett, 38 Melrose Ave., East Orange, N. J. 1946
Cabrera, Angel L., Museo de La Plata, La Plata, Argentina 1941
Cain, Stanley A., Cranbrook Inst. of Science, Bloomfield Hills, Mich. 1937
Caird, Ralph W., 11227 S. Artesian Ave., Chicago, Ill. 1944
Calvo, St. Manuel Quiros, Escuela de Farmacía, Universidad de Costa Rica, San José de Costa Rica 1943
Camp, W. H., The New York Botanical Garden, New York 58, N. Y. 1936
Campbell, W. A., School of Forestry, University of Georgia, Athens, Ga. 1937
Carey, Cornelia L., Barnard College, Columbia University, N. Y. 27, N. Y. 1918
Castellanos, Alberto, Museo de Ciencias Naturales, Chubut 450, Buenos Aires, Argentina 1939
Castle, Hempstead, Osborn Botanical Laboratory, Yale University, New Haven, Conn. 1942
Celestine, Brother, Manhattan College, New York, N. Y. 1941
Chamberlain, Glen D., 22 Academy St., Presque Isle, Maine 1939
Chandler, Clyde, 28 Caryl Ave., Yonkers, N. Y. 1927
Cheadle, Vernon, Botany Dept., Rhode Island State College, Kingston, R. I. 1940
Chen, Shan-Ming, c/o Dr. K. W. Wegner, 105 Winona St., Northfield, Minn. 1944
Cheney, Ralph Holt, Biology Dept. Brooklyn College, Bedford Ave. & Ave. H, Brooklyn 10, N. Y. 1924
Chrysler, M. A., P. O. Box 34, Chaplin, Conn. 1924
Clapp, Grace L., R.R., Windsor Locks, Conn. 1931
Clark, Marie B., 1420 Duncan St. N.E., Washington, D. C. 1940
Clausen, Robert T., Dept. of Botany, Cornell University, Ithaca, N. Y. 1934
Clokey, Ira W., 1635 Laurel St., South Pasadena, Calif. 1920
Clum, Harold H., Dept. of Biological Sciences, Hunter College, 695 Park Ave., New York 21, N. Y. 1928
Cohen, Isadore, American International College, Springfield, Mass. 1948
Conant, George H., Ripon, Wis. 1940
Constance, Lincoln, 80 Buckingham St., Cambridge 38, Mass. 1941
Cooper, Isaiah Cleeve Gordon, 280 Bidwell Ave., Staten Island 2, N. Y. 1946
Cooper, William S., Dept. of Botany, University of Minnesota, Minneapolis, Minn. 1931
Crocker, William, Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1924
Cronquist, Arthur, University of Georgia, Athens, Ga. 1944
Cross, G. L., Dept. of Botany, University of Oklahoma, Norman, Okla. 1937
Cuatrecasas, José, Chicago Natural History Museum, Roosevelt Rd. and Field Drive, Chicago, Ill. 1940
Cummins, George B., Agr. Exp. Station, Lafayette, Ind. 1939
Curtis, John T., Botany Dept., University of Wisconsin, Madison 6, Wis. 1948
Cutter, Victor M., Osborn Botanical Lab., Yale University, New Haven, Conn. 1942
Dahl, Orville A., Dept. of Botany, University of Minnesota, Minneapolis 14, Minn. 1941
Dale, E. E., Dept. of Biology, Union College, Schenectady, N. Y. 1930
Dansereau, Pierre, Université de Montréal, 2900 Blvd. du Mont Royal, Montréal Canada 1945

Darker, Grant D., Ben Venue Labs. Inc., Bedford, Ohio 1935
Davies, P. A., Dept. of Biology, University of Louisville, Louisville 8, Ky. 1934
Davis, Ray J., University of Idaho, Southern Branch, Pocatello, Idaho 1939
Dayton, William A., c/o Forest Service, U. S. Dept. Agr., Washington 25, D. C. 1921
Deam, Charles C., Bluffton, Indiana 1929
De Blasio, Mary, St. Luke's Hospital, 113th St. & Amsterdam Ave., New York 25, N. Y. 1948
DeLameter, Edward D., Mycology Lab., Mayo Clinic, Rochester, Minn. 1945
Demaree, Delzie, Arkansas State College, Jonesboro, Ark. 1940
Dennis, Parley W., Michigan State College, East Lansing, Mich. 1948
Denny, F. E., Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1928
Denny, Grace, 1104 Houston Ave., Crockett, Tex. 1948
Descole, Horacio R., Miguel Lillo 205, Tucuman, Argentina 1939
Deslogc, Joseph, Florissant, Missouri 1944
Devine, Verona, Botany Dept., University of Iowa, Iowa City, Iowa 1946
Diehl, William W., Mycology & Disease Survey, Plant Industry Station, Beltsville, Md. 1945
Dodd, John D., Dept. of Botany, University of Wisconsin, Madison, Wis. 1947
Dodge, B. O., 3001 Valentine Ave., New York 58, N. Y. 1910
Dodge, Carroll W., Missouri Botanical Garden, 2315 Tower Grove Ave., St. Louis 10, Mo. 1928
Dohrmann, Lawrence O., 30-68 37th St., Long Island City 3, N. Y. 1939
Doty, H. S., 911 Buxton St., Indianola, Iowa 1944
Douglas, Gertrude Elizabeth, 205 Lancaster St., Albany 6, N. Y. 1940
Drechsler, Charles, Bureau of Plant Industry Station, Beltsville, Md. 1921
Drexler, R. V., Coe College, Cedar Rapids, Iowa 1944
Drouet, Francis, Chicago Natural History Museum, Roosevelt Rd. & Lake Michigan, Chicago, Ill. 1937
Ducharme, Ernest P., Citrus Exp. Station, Lake Alfred, Fla. 1945
Duggar, Benjamin M., Pearl River Apts., Pearl River, N. Y. 1948
Dulaney, E. L., Microbiological Research, Merck & Co., Rahway, N. J. 1946
Duman, Maximilian C., Dept. of Biology, St. Vincent College, Latrobe, Pa. 1947
Duncan, Robert E., 105 Biology Building, University of Wisconsin, Madison 6, Wis. 1940
Dunham, Mrs. F. G., 450 Beverly Rd., Ridgewood, N. J. 1934
Dunlop, Douglas W., Botany Dept., University of Wisconsin Ext., Milwaukee, Wis. 1941
Dutcher, Catherine, Hillside Terrace, Irvington, N. Y. 1925
Dwyer, John D., 4a Maple Ave., Albany 3, N. Y. 1937
Earle, T. T., Dinwiddie Hall, Tulane Univ., New Orleans 15, La. 1938
Ebel, Guillermo, Colegio San Javier, Casilla 57, Puerto Montt, Chile, S. A. 1941
Eckert, Theodore E., Whitney Point, N. Y. 1945
Edwards, James L., 27 Stanford Place, Montclair, N. J. 1937
Egler, Frank E., Norfolk, Conn. 1943
Eichorn, Paul A., 326 Carroll Ave., Mamaroneck, N. Y. 1946
Ellison, Lee A., 66 Haven Esplanade, Staten Island 1, New York 1948
Emerson, Ralph, Dept. of Botany, University of California, Berkeley, Calif. 1940
Emmons, Maryhelen, Dept. of Plant Pathology, University of Arizona, Tucson, Ariz. 1948
Emsweller, S. L., Bureau of Plant Industry Station, Beltsville, Md. 1948
Epling, Carl, 372 South Carmelina Ave., Los Angeles, Calif. 1941
Ericson, Charles, 881 Washington Ave., Brooklyn 25, N. Y. 1939
Ewan, Joseph, Dept. of Botany, Tulane University, New Orleans, La. 1934
Eyster, William Henry, Organic Gardening Magazine, Emmaus, Pa. 1941
Fairchild, Stephen J., P. O. Box 645, Santa Maria, Calif. 1948
Farr, Wanda K., Celanese Research Labs., Summit, N. J. 1941
Fassett, Norman C., Biology Building, University of Wisconsin, Madison 6, Wis. 1928

Fawcett, Howard S., Citrus Exp. Station, University of California, Riverside, Calif. 1943
Fay, Dolores J., 115 South 11th St., Newark 7, N. J. 1932
Fernald, Evelyn I., Rockford College, Rockford, Ill. 1931
Ferri, G., Dept. de Botânica, Al Glete, 463 Caixa Postal, 105 B São Paulo, Brasil 1947
Field, Allan J., 115 Oakwood Ave., Cliffside Park, N. J. 1946
Fischer, George W., Agr. Exp. Station, Pullman, Wash. 1943
Fisher, G. Clyde, American Museum of Natural History, 77th St. & Central Park West, New York, N. Y. 1914
Fisher, Francine E., Citrus Exp. Station, Lake Alfred, Fla. 1948
Fisk, Emma L., Dept. of Botany, University of Wisconsin, Madison 6, Wis. 1946
Fletcher, Mary T., 82–10 Beverly Rd., Kew Gardens, N. Y. 1929
Fluekiger, Dora W., Hotel Dauphin, Broadway & 67th St., New York 23, N. Y. 1946
Fogg, John M., Jr., Dept. of Botany, University of Pennsylvania, Philadelphia 4, Pa. 1927
Ford, Ernest S., Dept. of Botany, University of Florida, Gainesville, Fla. 1948
Foster, Adriance S., Dept. of Botany, University of California, Berkeley, Calif. 1935
Fox, Lauretta Ewing, Dept. of Biological Science, Cincinnati College of Pharmacy, Cincinnati 3, O. 1941
Frazee, V. L., Allenwood, N. J. 1930
Fread, Bernard, 45 E. 85th St., New York 28, N. Y. 1930
Fulford, Margaret, Dept. of Botany, University of Cincinnati, Cincinnati 21, Ohio 1941
Fuller, George D., Illinois State Museum, Springfield, Ill. 1944
Fulling, Edmund H., 20 South Rd., Bronxville, N. Y. 1929
Fulmer, W. L., 505 Boylston Ave., No., Seattle, Wash. 1948
Gaige, Edward E., 181 Euclid Ave., Hackensack, N. J. 1938
Garber, Edward D., Division of Genetics, University of California, Berkeley 4, Calif. 1948
Garcia, Victor, Pena 3130, 2° Piso "B", Buenos Aires, Argentina 1944
Gaudron, Julio, Box 2022, Lima, Peru 1943
Gentry, Howard Scott, Hancock Foundation, Univ. So. Calif., Los Angeles 7, Calif. 1947
Gerry, Eloise, U. S. Forest Products Laboratory, Madison 5, Wis. 1927
Gilbert, W. J., Dept. of Biology, Albion College, Albion, Mich. 1946
Gill, Richard G., P. O. Box 281, Palo Alto, Calif. 1946
Gilly, Charles, Dept. of Botany, Iowa State College, Ames, Iowa 1940
Gilmer, Ralph, P. O. Box 304, Morgan Hill, Calif. 1948
Goddard, David R., Dept. of Botany, University of Pennsylvania, Philadelphia 4, Pa. 1948
Goodman, George J., Dept. of Plant Sciences, University of Oklahoma, Norman, Okla. 1937
Goodwin, Richard H., Dept. of Botany, Connecticut College, New London, Conn. 1943
Gotz, Mathilde, 410 Riverside Drive, N. Y. 1944
Graham, Margaret A., 320 Riverside Drive, New York, N. Y. 1915
Grassl, Carl O., Division of Sugar Plant Investigations, Bureau of Plant Industry, Beltsville, Md. 1940
Graves, Arthur H., 255 South Main St., Wallingford, Conn. 1922
Greenman, J. M., Missouri Botanical Garden, St. Louis 10, Mo. 1940
Gunckel, James E., Dept. of Botany, Rutgers University, New Brunswick, N. J. 1944
Gundersen, Alfred, 99 Ulster Ave., Saugerties, N. Y. 1916
Gustafson, Felix G., Botany Dept., University of Michigan, Ann Arbor, Mich. 1948
Habeeb, Herbert, Grand Falls, New Brunswick, Canada 1944
Hammond, Dorothy, Hunter College, 695 Park Ave., New York 21, N. Y. 1930
Hand, Louis E., 8061 Fairview St., Holmesburg, Philadelphia 36, Pa. 1939
Hanlon, James J., 328 W. 14th St., New York 14, N. Y. 1942
Hansen, H. N., 108 Hilgard Hall, University of California, Berkeley, Calif. 1937
Hansen, Henry P., Dept. of Botany, Oregon State College, Corvallis, Ore. 1940
Hanson, Anne M., 175 W. 76th St., New York 23, N. Y. 1941

Hara, Hiroshi, The Arnold Arboretum, Jamaica Plain 30, Mass. 1940
Haring, Inez M., c/o Dr. Edith Roberts, Vassar College, Poughkeepsie, N. Y. 1926
Harper, Mrs. R. A., R. R. Bedford, Va. 1920
Harvey, Leroy H., Dept. of Botany, Montana State University, Missoula, Mont. 1946
Haskins, R. H., Biological Laboratories, Harvard University, Cambridge 38, Mass. 1948
Hastings, George T., 842 19th St., Santa Monica, Calif. 1912
*Hein, Illo, 1803 Riverside Drive, New York 34, N. Y. 1945
Heiser, Charles B., Jr., Dept. of Botany, Indiana University, Bloomington, Ind. 1947
Hervey, Annette, 175 W. 93rd St., New York 25, N. Y. 1941
Heusser, Calvin J., 332 E. Columbia Ave., Palisades Park, N. J. 1948
Higgins, B. B., Dept. of Botany, Georgia Exp. Station, Experiment, Ga. 1933
Higinbotham, Noe, Dept. of Botany, State College of Washington, Pullman, Wash. 1937
Hillier, Mrs. W. H., 5521 Blackstone Ave., Chicago 37, Ill. 1943
Hires, Clara S., 152 Glen Ave., Mistaire Labs., Millburn, N. J. 1942
Hitchcock, A. E., Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1929
Hollinghurst, Honor, 2546 Creston Ave., New York, N. Y. 1933
Hopkins, J. G., 102 E. 78th St., New York 21, N. Y. 1938
Hopkins, Milton, c/o Mrs. S. L. Hewlett, Roslyn, N. Y. 1943
Hoskins, Barbara, Chappaqua, N. Y. 1945
House, H. D., New York State Museum, Albany, N. Y. 1935
Huber, William H., Box 175, Bard Hall, 50 Haven Ave., New York 32, N. Y. 1947
Hunnewell, Francis Welles, Washington St., Wellesley 81, Mass. 1930
Hunt, Mrs. Roy A., 4875 Ellsworth Ave., Pittsburgh, Pa. 1941
Ivanoff, S. S., Dept. of Plant Pathology, Mississippi Agr. Exp. Station, State College, Miss. 1941
Ivimey-Cook, W. R., University College, Newport Rd., Cardiff, Wales 1937
Jacobs, Charlotte M., 209 Lincoln Place, Brooklyn, N. Y. 1939
Jacques, Emile J., Montreal Botanical Garden, Montreal, Canada 1940
Jakowska, Sophie, 2540 Cambreleng Ave., New York 58, N. Y. 1948
James, Lois E., Dept. of Biology, Whittier College, Whittier, Calif. 1947
Jennings, Otto E., Carnegie Museum, Pittsburgh, Pa. 1926
Jimenez A., José de Js., José T. Valdez 112, Santiago, Dominican Rep. 1943
Johanson, Alfhild Elizabeth, 730 Cranford Ave., New York 66, N. Y. 1931
Johns, Louis E., Dept. of Music, Skidmore College, Saratoga Springs, N. Y. 1941
Johnson, Marion A., Rutgers University, New Brunswick, N. J. 1942
Jones, Clyde H., Dept. of Botany, Ohio State University, Columbus, Ohio 1940
Joshi, A. C., Govt. College, Lahore, India 1947
Jud, Frieda C., 42 W. 35th St., New York 1, N. Y. 1916
Jurica, Hilary S., St. Procopius College, Lisle, Ill. 1919
Just, Theodor, Chicago Natural History Museum, Roosevelt Rd., Lake Shore Dr., Chicago 5, Ill. 1935
Kaeiser, Margaret, Dept. of Botany, Southern Illinois University, Carbondale, Ill. 1948
Kalmykow, Alexandra, 51 Bennett Ave., New York 33, N. Y. 1941
Karling, John S., Dept. of Botany, Columbia University, New York 27, N. Y. 1928
Kasapligil, Baki, International House, Berkeley 4, Calif. 1947
Kavanagh, Frederick, The New York Botanical Garden, New York 58, N. Y. 1940
Kavanagh, Virgene W., The New York Botanical Garden, New York 58, N. Y. 1940
Keck, David D., Carnegie Institution, Stanford, Calif. 1935
Keener, Paul, Dept of Plant Pathology, College of Agriculture, University of Arizona, Tucson, Ariz. 1947
Kelz, Francoise A., 31 Dobbs Terrace, Scarsdale, N. Y. 1942
Kemp, Margaret, Smith College, Northampton, Mass. 1941
Kennedy, H. Anna, 30 Park Ave., South Weymouth, Mass. 1941
Kiener, Walter, Game Forestation & Parks Comm., State Fair Grounds, Lincoln 3, Nebr. 1945
Kocher, Mrs. Edw. H., Reserve Rd., Boonton, N. J. 1946

* Deceased.

Koffler, Anna H., P. O. Box 931, New Brunswick, N. J.	1944
Kolk, Laura Alma, 416 Ocean Ave., Brooklyn, N. Y.	1925
Kopf, Kenneth, Hawaiian Pineapple Co., Honolulu 1, T. H.	1938
Korf, R. P., Dept. of Plant Pathology, Cornell University, Ithaca, N. Y.	1946
Kosanke, Robert M., Illinois Geological Survey, Urbana, Ill.	1948
Koster, Hollis, Greenbank, N. J.	1941
Krukoff, Boris A., The New York Botanical Garden, New York 58, N. Y.	1941
Kuehn, Viola, 11303 Normal Ave., Chicago, Ill.	1944
Kunkel, L. O., Rockefeller Institute for Medical Research, Princeton, N. J.	1925
Lakela, Olga, University of Minnesota, Duluth Branch, Duluth, Minn.	1943
Lalonde, Pere Louis M., La Trappe, Quebec, Canada	1935
Larisey, Mary Maxine, 2 Franklin St., Charleston, So. Carolina	1941
La Rue, Carl D., University of Michigan, Ann Arbor, Mich.	1936
Lasser, Tobias, AP Postal 255, Caracas, Venezuela	1940
Laurence, Maria, Marywood College, Scranton, Pa.	1947
Lawton, Elva, 205 E. 69th St., New York 21, N. Y.	1929
Lee, Mrs. Raymond C., Box 552, Seward, Alaska	1938
León, Brother, (Joseph Sylvestre Sauget), Colegio de la Salle, Vedado, Habana, Cuba	1941
Leutritz, John, Jr., Bell Telephone Laboratories, Summit, N. J.	1937
Levine, Darwin, 4030 Surf Ave., Brooklyn 24, N. Y.	1934
Levine, Michael, 100 Halsted Ave., Yonkers 4, N. Y.	1909
Lewis, Clarence, 1000 Park Ave., New York 28, N. Y.	1932
Lewis, F. H., Dept. of Botany, University of California, Los Angeles, Calif.	1946
Leyendecker, Philip J., New Mexico College, A. & M., State College, N. Mex.	1943
Lier, Frank G., 141–12 181st St., Springfield Gardens 13, N. Y.	1942
Linsdale, Jean M., Jamesburg Route, Monterey, Calif.	1943
Longacre, Dorothy J., 11 Adams St., Sea Cliff, N. Y.	1941
Loomis, W. E., Dept. of Botany, Iowa State College, Ames, Iowa	1940
Looser, Gualterio, Casilla 5542, Santiago 6, Chile	1940
Loughridge, Gasper A., Dept. of Biology, Davis & Elkins College, Elkins, W. Va.	1940
Love, Askell, Institute of Botany & Genetics, Reykjavik, Iceland	1947
Lownes, Albert E., P. O. Box 1531, Providence, R. I.	1922
Lowry, Robert J., Dept. of Botany, Michigan State College, East Lansing, Mich.	1948
Lucas, Eugene H., Dept. of Horticulture, Michigan State College, East Lansing, Mich.	1948
Lundell, C. L., Southern Methodist University, Dallas, Tex.	1937
Lupton, Burritt K., Franklin Ave., Wyckoff, N. J.	1941
Lutz, H. J., Yale School of Forestry, New Haven, Conn.	1940
Lyon, Ellen Sanders, Campbellsville, Kentucky	1947
Lyon, Harold L., Exp. Station, H. S. P. A., Honolulu, Hawaii	1940
McAvoy, Blanche, 108 W. Ash St., Normal, Ill.	1940
McCullough, Herbert A., Dept. of Biology, Howard College, Birmingham 6, Ala.	1938
McFarland, Frank T., Dept. of Botany, University of Kentucky, Lexington, Ky.	1935
McGrath, James, 2135 South St., Fort Lee, N. J.	1948
McNair, James, 818 South Ardmore Ave., Los Angles 5, Calif.	1935
Ma, Roberta, Rm. 117, North Bldg., Agr. Res. Center, Beltsville, Md.	1941
Maceo, Mrs. Josefa Velazquez, Biology Dept., University of Puerto Rico, Rio Piedras, P. R.	1932
Macht, David I., 3420 Auchentoroly Terrace, Baltimore 17, Md.	1948
Maguire, Bassett, The New York Botanical Garden, New York 58, N. Y.	1944
Mahony, Patricia, 55 W. 95th St., New York 25, N. Y.	1938
Mains, E. B., University Herbarium, Museum Bldg., University of Michigan, Ann Arbor, Mich.	1935
Malone, Edna J., 3045 Palisade Ave., New York 63, N. Y.	1939
Manchak, Anna, 625 E. 5th St., New York 9, N. Y.	1947

Manning, Wayne E., 27 Brown St., Lewisburg, Pa.	1942
Manton, Irene, Botany Dept., Leeds University, Leeds 2, England	1948
Martin, James S., Science Div., Eastern New Mexico College, Portales, N. M.	1946
Marvin, James W., Box 204A, R.R. 1, Burlington, Vt.	1934
Massey, A. B., Virginia Polytechnic Institute, Blacksburg, Va.	1945
Massoth, Corrine F., 3224 Barnes Ave., New York 67, N. Y.	1948
Matthews, Velma D., Coker College, Hartsville, S. C.	1937
Matzke, Edwin B., 3190 Perry Ave., New York 67, N. Y.	1925
Meier, Dorothy, 3 E. 66th St., New York 21, N. Y.	1931
Melhus, Irving E., Iowa State College Tropical Res. Center, Antigua, Guatemala	1943
Meredith, Clifford, Apartado No. 669, Maracay, Venezuela	1941
Merrill, Elmer D., Arnold Arboretum, Jamaica Plain 30, Mass.	1930
Metzner, Jerome, 55 Cooper St., New York, N. Y.	1943
Middleton, John T., University of California, Riverside, Calif.	1943
Milhone, Damian W., O. S. B., St. Bede College, Peru, Ill.	1941
Miller, Helena A., Botany Dept., Wellesley College, Wellesley 81, Mass.	1948
Miller, Joseph Austin, 364 Prospect St., S. Orange, N. J.	1942
Mira, M. Sister, O. S. E., 1413 Layton Blvd., Milwaukee, Wis.	1936
Mitchell, Mrs. William, 54 Hancock Ave., Lincoln Park, Yonkers 5, N. Y.	1927
Moldenke, Harold N., The New York Botanical Garden, New York 58, N. Y.	1929
Moldenke, Mrs. Harold N., 821 E. 226th St., New York 66, N. Y.	1934
Montagne, Henry de la, Jr., 198 Chatterton Parkway, White Plains, N. Y.	1936
Mook, Paul V., 1715 Central Court, Apt. 4, Gulfport, Miss.	1941
Moon, M'Della, Lincoln Hall Dormitory, Bluffton, Ohio	1943
Morris, Helen S., 453 Kimball Ave., Yonkers, N. Y.	1929
Muenscher, Walter Conrad, 1001 Highland Rd., Ithaca, N. Y.	1941
Munz, Philip, R.F.D. 3, Box 327-B, Anaheim, Calif.	1922
Murphy, James, 122 E. 42nd St., New York 17, N. Y.	1930
Myers, Maurice R., Dept. of Biology, Western Illinois State College, Macomb, Ill.	1947
Myers, W. Stanley, 818 Eubanks St., Oklahoma City, Okla.	1940
Nauss, Mrs. Ralph W., 1303 York Ave., New York 21, N. Y.	1943
Naylor, A. W., Dept. of Botany, Yale University, New Haven, Conn.	1946
Naylor, Ernest E., The New York Botanical Garden, New York 58, N. Y.	1939
Neal, Oliver M., Jr., Authurdale, W. Va.	1948
Nearing, G. G., P.O. Box 131, Demarest, N. J.	1935
Neidorf, Charles, 127 Cannon St., New York, N. Y.	1947
Nestler, Leonie Jane, 184 Engle St., Tenafly, N. J.	1943
Nickell. Louis G., Osborn Botanical Lab., Yale University, New Haven, Conn.	1948
Niklas, Geo., 454 W. 36th St., New York 18, N. Y.	1947
Nolla, J. A. B., Agr. Exp. Station, Mayaguez, Puerta Rico	1928
Northcraft, Richard D., New Jersey Hall, Rutgers University, New Brunswick, N. J.	1948
O'Hanlon, Mary Ellen, OP, Rosary College, River Forest, Ill.	1945
Olcott, Mary, Casagmo, Ridgefield, Conn.	1943
O'Neill, Hugh T., Catholic University of America, Washington, D. C.	1948
Oosting, Henry J., Dept of Botany, Duke University, Durham, N. C.	1939
Ousdal, A. P., P.O. Box 807, Santa Barbara, Calif.	1944
Ownbey, Marion, Dept. of Botany, State College of Washington, Pullman, Wash.	1946
Palmatier, Elmer A., Botany Dept., Rhode Island State College, Kingston, R. I.	1948
Papke, Pauline M., 115 Montague St., Brooklyn, N. Y.	1943
Parks, Harold E., Spruce Cove, Trinidad, Calif.	1940
Parodi, Lorenzo R., Lavalle 4680, Buenos Aires, Argentina	1939
Pease, Dorothy, Brooklyn College, Bedford Ave. & Ave. H, Brooklyn, N. Y.	1935
Peloubet, S. W., 228 Sagamore Rd., Maplewood, N. J.	1933
Perlman, D., 35 Edghill St., Princeton, N. J.	1947
Pfeiffer, Norma E., Boyce Thompson Institute for Plant Research, Yonkers, N. Y.	1928
Phillips, Walter, 109 E. Palisade Ave., Englewood, N. J.	1940

Pieczur, Elizabeth A., 953 Faile St., New York 59, N. Y. 1947
Piemeisel, Robert L., Box 826, Twin Falls, Idaho 1940
Pireira-Fillio, Manuel José, Rua Voluntarios da Patria 405, Porto Alegre, Rio Grande do Sul, Brasil 1948
Pirone, P. P., The New York Botanical Garden, New York 58, N. Y. 1948
Pittier, Henri, P.O. Box 255, Caracas, Venezuela 1939
Platt, Robert S., Jr., 10820 Drew St., Chicago, Ill. 1941
Platt, Rutherford, 386 4th Ave., New York 16, N. Y. 1938
Pokorny, Frank J., College of Pharmacy, Columbia Univ., 115 W. 68th St., New York 23, N. Y. 1929
Pollak, Ruth Ann, 10313 So. Denker Ave., Los Angeles 44, Calif. 1946
Ponewczynski, Helen, 1148 Clay Ave., New York 56, N. Y. 1948
Pool, Raymond J., Univ. of Nebraska, Lincoln 8, Neb. 1915
Porterfield, Willard M., Jr., 3640 39th St. N.W., Washington 16, D. C. 1922
Presley, John T., Dept. of Plant Pathology, Agr. Exp. Station, State College, Miss. 1942
Pulle, A. A., Botanical Museum & Herbarium, University of Utrecht, Lange Nieuwstraat 105, Utrecht, Netherlands 1938
Pulling, H. E., Wellesley College, Wellesley, Mass. 1927
Puri, V., Botany Dept., Meerut College, Meerut, India 1947
Raines, M. A., 7204 7th St. N.W., Washington 12, D. C. 1932
Raska, Clara A., 21–14 149th St., Whitestone, N. Y. 1937
Raup, Hugh M., Arnold Arboretum, Jamaica Plain 30, Mass. 1937
Reed, C. F., Box 226, Morehead State Teachers College, Morehead, Ky. 1945
Reed, Fredda Doris, Mount Holyoke College, South Hadley, Mass. 1931
Reeder, John R., Osborn Botanical Laboratory, Yale University, New Haven, Conn. 1948
Regan, John J., Niagara University P. O., Niagara University, N. Y. 1943
Reif, Charles B., Bucknell University Junior College, Wilkes-Barre, Pa. 1940
Rettew, G. Raymond, Box 15, West Chester, Pa. 1948
Rhoades, M. M., Botany Dept., Columbia University, New York, N. Y. 1941
Rickett, H. W., The New York Botanical Garden, New York 58, N. Y. 1940
Riley, Herbert Parkes, Dept. of Botany, University of Kentucky, Lexington, Ky. 1940
Rissanen, William, 516 W. 167th St., New York 32, N. Y. 1946
Ritchie, C. L., P.O. Box 340, Honolulu 9, T. H. 1948
Robbins, G. Thomas, Biology Dept., East Central State College, Ada, Okla. 1942
Robbins, William J., The New York Botanical Garden, New York 58, N. Y. 1937
Roberts, Edith A., Dept. of Plant Science, Vassar College, Poughkeepsie, N. Y. 1943
Roddis, Louis Harry, 6 Poe Rd., Bethesda, Md. 1940
Rogers, David J., Missouri Botanical Garden, 2315 Tower Grove Ave., St. Louis 10, Mo. 1947
Rogers, Donald P., The New York Botanical Garden, New York 58, N. Y. 1947
Rogers, Walter E., P.O. Box 385, Appleton, Wis. 1934
Rogerson, Clark T., Dept. of Plant Pathology, Cornell University, Ithaca, N. Y. 1945
Rork, Crystal L., Houghton College, Houghton, N. Y. 1948
Rosendahl, C. O., Dept. of Botany, University of Minnesota, Minneapolis 14, Minn. 1935
Routien, John B., Chas. Pfizer & Co., 11 Bartlett St., Brooklyn 6, N. Y. 1948
Rudolph, Emanuel D., 2042 Bedford Ave., Brooklyn 26, N. Y. 1948
Ruehle, George D., Subtropical Exp. Station, Homestead, Fla. 1940
Runge, Anna G., 3529 34th St., Long Island City, N. Y. 1919
Runyon, Robert, 812 South Charles St., Brownsville, Texas 1935
Rusk, Hester M., Brooklyn Botanic Garden, 1000 Washington Ave., Brooklyn 25, N. Y. 1919
Sadler, Nettie M., 503 Allen St., Syracuse, N. Y. 1942
Saeger, Albert, Dept. of Biology, University of Kansas City, 5100 Rockhill Rd, Kansas City 4, Mo. 1929
St. John, Harold, Dept. of Botany, University of Hawaii, Honolulu, Hawaii 1928
Salisbury, Robert Kenneth, Russelville, Ohio 1943

Sartoris, George B., Plant Industry Station, Beltsville, Md. 1944
Savacool, Ethel, 503 W. 121st St., New York 27, N. Y. 1927
Schmitt, Chris G., Boyce Thompson Institute, Yonkers, N. Y. 1947
Schneider, William E. H., Jr., 90 Engle St., Englewood, N. J. 1942
Schnell, C. L., U. S. Marine Hospital, Stapleton, New York, N. Y. 1947
Schopfer, William-Henri, Botanical Institute, Univ. of Bern, Altenbergrain 21, Bern, Switzerland 1940
Schwarten, Lazella D., Arnold Arboretum, Jamaica Plain 30, Mass. 1940
Scully, Francis J., 904 Medical Arts Building, Hot Springs, Ark. 1935
Sears, Paul B., Oberlin College, Oberlin, Ohio 1940
Seaver, Fred J., The New York Botanical Garden, New York 58, N. Y. 1940
Seifert, Caroline L., N. Liberty St., Nantucket, Mass. 1918
Seigerman, Norman, 1729 E. 16th St., Brooklyn 29, N. Y. 1947
Senn, Harold A., Division of Botany, Central Exp. Farm, Ottawa, Ont. 1940
Severy, J. W., Dept. of Botany, Montana State University, Missoula, Mont. 1935
Sharp, Aaron J., University of Tennessee, Knoxville, Tenn. 1947
Shippy, William B., R.R. 1, Box 72B, Sanford, Fla. 1935
Shirk, Claude J., Nebraska Wesleyan University, University Place, Lincoln, Neb. 1928
Shive, John W., N. J. Agr. Exp. Station, New Brunswick, N. J. 1934
Shultz, O., 35 50th St., Weehawken, N. J. 1944
Silveira, Verlande Duarte, Rua Visconde de Piraja nº 583, c.l. Rio de Janeiro, Brasil 1948
Simpson, Jennie L. S., Hunter College, 695 Park Ave., New York 21, N. Y. 1930
Sinnott, Edmund W., Osborn Botanical Laboratory, Yale University, New Haven, Conn. 1928
Slater, William A., 1060 Morewood Ave., Pittsburgh, Pa. 1941
Sleeth, Bailey, 1461 Seventh Ave., Yuma, Arizona 1948
Small, John A., New Jersey College for Women, New Brunswick, N. J. 1932
Smiley, Daniel, Jr., Lake Mohonk Mountain House, Mohonk Lake, N. Y. 1935
Smith, Albert C., Arnold Arboretum, Jamaica Plain 30, Mass. 1929
Smith, Alexander H., Museum Bldg., University of Michigan, Ann Arbor, Mich. 1935
Smith, Edward, 127 U. S. Court House, El Paso, Texas 1948
Smith, Ora B., 821 Bergen Ave., Jersey City 6, N. J. 1928
Solheim, W. G., Dept. of Botany, University of Wyoming, Laramie, Wyo. 1945
Soukup, Jaroslav, S. S., Box 999, Lima, Peru 1944
Spackman, Wm., Jr., Biological Laboratories, Harvard University, Cambridge 38, Mass. 1945
Sperry, Omer E., F.E. 24, College Station, Texas 1935
Sperry, John J., P.O. Box 4922, College Station, Texas 1948
Spitzer, Edith L., 1615 Townsend Ave., New York 52, N. Y. 1948
Stakman, E. C., University Farm, St. Paul 8, Minn. 1933
Steere, William C., Botany Dept., University of Michigan, Ann Arbor, Mich. 1935
Steil, W. N., 1926 North 53rd St., Milwaukee, Wis. 1922
Steinberg, Robert A., Bureau of Plant Industry Station, Tobacco Inv., Beltsville, Md. 1934
Steiner, G., Bureau of Plant Industry, U. S. Dept. Agr., Washington, D. C. 1941
Stevens, Neil E., Dept. of Botany, University of Illinois, Urbana, Ill. 1940
Stevenson, John A., 4113 Emery Place N.W., Washington 16, D. C. 1940
Stewart, E. Grace, 44 Washington Ave., Wilmette, Ill. 1915
Stewart, R. R., Gordon College, Rawalpindi, India 1943
Stickney, Nila, River Rd., Columbia, N. J. 1946
Steyermark, Julian A., Chicago Natural History Museum, Chicago 5, Ill. 1948
Stokey, Alma G., Mt. Holyoke College, South Hadley, Mass. 1935
Stork, Harvey E., Dept. of Biology, Carleton College, Northfield, Minn. 1920
Stout, A. B., The New York Botanical Garden, New York 58, N. Y. 1912
Stratton, Robert, 409 Ramsey St., Stillwater, Okla. 1931

Svenson, Henry K., American Museum of Natural History, New York 23, N. Y.	1930
Swayer, Esther K., 1131 E. 4th St., Brooklyn 30, N. Y.	1946
Taft, Clarence E., Botany Dept., Ohio State University, Columbus, O.	1937
Tanger, Mrs. Charles Y., 318 N. President Ave., Lancaster, Pa.	1938
Taylor, William R., Dept. of Botany, University of Michigan, Ann Arbor, Mich.	1936
Tehon, Leo R., 337 Natural Resources Bldg., Urbana, Ill.	1948
Tepfer, Sanford S., 863 Vermont St., Oakland 10, Calif.	1940
Tewksbury, R. B., Fruit Dispatch Co., Pier 7 North River, New York 6, N. Y.	1943
Tharp, B. C., Dept. of Botany, University of Texas, Austin 12, Tex.	1944
Thom, Charles, Port Jefferson, N. Y.	1943
Thomson, John W., Jr., Dept. of Botany, University of Wisconsin, Madison 6, Wis.	1932
Thwing, Walter E., Chestnut Hill, R.R. 1, Wilton, Conn.	1941
Tilden, Josephine E., Wistaria Place, Golden Bough Colony, Lake Wales, Fla.	1945
Trelease, Sam F., Dept. of Botany, Columbia University, New York 27, N. Y.	1925
Tseng, C. K., Dept. of Botany, University of Shantung, Tsingtao, China	1948
Utter, L. Gordon, Phelps Dodge Refining Corp., 40 Wall St., New York 5, N. Y.	1930
Venard, Haskell, 125 Montgomery Ferry Dr., Atlanta 5, Ga.	1947
Vestal, Mary R., Rollins College, Winter Park, Fla.	1936
Vestal, Wanda P., 309½ W. Columbia Ave., Champaign, Ill.	1935
Vlitos, August John, 232 Duck St., Stillwater, Okla.	1948
Von Kleinsmid, R. B., University of Southern California, Los Angeles, Cal.	1919
Voth, Paul D., Dept. of Botany, University of Chicago, Chicago 37, Ill.	1945
Walker, Mrs. Roland, Biological Laboratory, Rensselaer Polytechic Institute, Troy, N. Y.	1935
Warmke, Harry E., U. S. Dept. Agr. Fed. Exp. Station, Mayaquez, Puerto Rico	1940
Warren, J. R., Botany Dept., Duke University, Durham, N. C.	1948
Watkins, G. M., 10103 McKinney Ave., Silver Springs, Md.	1931
Weatherwax, Paul, 416 S. Dunn St., Bloomington, Ind.	1918
Webber, Irma E., 3644 Beechwood Pl., Riverside, Calif.	1944
Weingartner, Anna J., 17 Amelia Court, Staten Island 10, N. Y.	1947
Weinig, A. J., 509 14th St., Golden, Colorado	1946
Welch, Winona H., Dept. of Botany, De Pauw University, Greencastle, Ind.	1931
Welti, Ethel, 23 76th St., North Bergen, N. J.	1941
Wenman, Lois M., Sand Springs Rd., Morristown, N. J.	1948
Went, F. W., Calif. Institute of Technology, Pasadena, Calif.	1940
West, Erdman, Agr. Exp. Station, Gainesville, Fla.	1928
Weston, William H., Jr., Biological Laboratories, Harvard University, Cambridge, Mass.	1931
Wetmore, Ralph H., Biological Laboratories, Harvard University, Cambridge, Mass.	1935
Whaley, W. Gordon, Dept. of Botany & Bacteriology, University of Texas, Austin 12, Tex.	1938
Whelden, Roy M., New Durham, N. H.	1940
Whitaker, Thomas W., P.O. Box 150, La Jolla, Calif.	1935
White, Alain, Summerville, S. C.	1937
Whitehouse, Eula, P.O. Box 739, Herbarium, So. Methodist University, Dallas 5, Texas	1940
Wiley, Farida A., American Museum of Natural History, 77th St. & Central Park W., New York 24, N. Y.	1933
Wilds, George James, Hartsville, S. C.	1941
Wilkens, Hans, 424 S. 15th St., Reading, Pa.	1935
Williams, Louis C., Escuela Agricola Panamericana, Apartado 93, Tegucigalpa, Honduras	1946
Winne, William T., Biology Dept., Union College, Schenectady, N. Y.	1948
Winter, John M., Dept. of Botany, South Dakota State College, Brookings, S. D.	1935
Winternitz, Elizabeth A., Apt. D. Gibson Terrace, Cambridge 38, Mass.	1948

Winterringer, Glen S., 208 Natural History Bldg., University of Illinois, Urbana, Ill. 1948
Witkus, Eleanor Ruth, Biological Laboratory, Fordham University, New York 58, N. Y. 1943
Wittrock, G. L., The New York Botanical Garden, New York 58, N. Y. 1935
Wodehouse, Roger P., Strawton Rd., New City, N. Y. 1927
Wolff, Emily T., 139 North Highland Rd., Springfield, Delaware Co., Pa. 1946
Wolf, F. T., Biology Dept., Vanderbilt University, Nashville 4, Tenn. 1940
Wolf, Frederick A., Dept. of Botany, Duke University, Durham, N. C. 1933
Wood, Richard D., Botany Dept., Rhode Island State College, Kingston, R. I. 1947
Wright, Kenneth E., Botany Dept., Smith College, Northampton, Mass. 1940
Young, P. Timothy, 78 Charles St., New York 14, N. Y. 1927
Yuncker, T. G., Dept. of Botany, De Pauw University, Greencastle, Ind. 1922
Yusef, Hasan M., The New York Botanical Garden, New York 58, N. Y. 1947
Zimmerman, P. W., Boyce Thompson Institute for Plant Research, Yonkers, N. Y. 1929

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Anderson, Gladys P., 1008 Boulevard, Westfield, N. J. 1946
Barag, Esther, 2995 Marion Ave., New York, N. Y. 1939
Bastinck, Francois, 22 Jefferson Ave., Jersey City 6, N. J. 1946
Bauer, Louise, 501 West 113th St., New York, N. Y. 1941
Berlow, Annette S., 305 Saratoga Ave., Brooklyn 33, N. Y. 1946
Berry, Eunice, 22 Webster Road, Orange, N. J. 1946
Blackburn, Harold, 667 East 232nd Street, New York, N. Y. 1946
Brown, Keith, 21 East 10th St., New York 3, N. Y. 1937
Brown, Margaret S., 36 Kent St., Halifax, Nova Scotia 1941
Browne, Dorothy L., Huntington, Box 538, N. Y. 1948
Buck, Margaret J., 8 Garden Place, Nutley 10, N. J. 1946
Busch, Phyllis B., 956 East 18th St., Brooklyn 30, N. Y. 1946
Chrystall, Frieda L., 311 East 72nd St., New York, N. Y. 1930
Chute, Hettie M., 37½ Jones Ave., New Brunswick, N. J. 1940
Conkling, Louella B., Apt. 43, 126 Sterling Place, Brooklyn, N. Y. 1937
Conn, Anna A., 95 Ben Lomond St., Uniontown, Pa. 1946
Constantine, Thomas S., 72 The Terrace, Katonah, N. Y. 1934
Coulter, Eleanor, 91 Early St., Morristown, N. J. 1947
Crabtree, John A., Montgomery, New York 1937
Davidson, Anna H., 120 West 105th St., New York 25, N. Y. 1941
Degener, Otto, Waialua, Oahu, Hawaii 1925
Dillman, Nora G., Box 335, Millburn, N. J. 1944
Dix, W. L., 801 Crown St., Morrisville, Pa. 1945
Donvan, Grace M., 1734 Jarvis Ave., New York 61, N. Y. 1941
Dotson, Henrietta W., 21 Gramercy Park, New York, N. Y. 1938
Drewes, Ellen W., 15 Brainerd St., Upper Montclair, N. J. 1941
Dudley, Katherine L., 509 West 122nd St., New York, N. Y. 1942
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Dustan, Alice L., 27 DeHart St., Morristown, N. J. 1947
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Elkan, Lilly, 48–02 43rd St., Woodside, N. Y. 1944
Epstein, Harold, 5 Forest Court, Larchmont, New York 1941
Erwin, Reiman G., 35 Powell Place, Stamford, Conn. 1941
Fox, R. A., 344 West 12th St., New York 14, N. Y. 1946
Friedman, B. A., Room 1022, 641 Washington St., New York 14, N. Y. 1946
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Gallanter, Justin, 105 Bennett Ave., New York 33, N. Y. 1944
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Ghirardi, O. S., 55 East 78th St., New York 21, N. Y. 1946

Goebel, Herman, 78–52 80th St., Brooklyn 27, N. Y.	1946
Gordon, H. B., Box 743, Hoboken, N. J.	1947
Gottlieb, Emanuel A., 675 West End Ave., New York, N. Y.	1941
Green, Anna Belle, 154 Claremont, Montclair, N. J.	1947
Green, Walter P., 15 Plank Road, Waterbury 42, Conn.	1947
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Gunnison, Mrs. R. M., Quaker Acres, Pawling, N. Y.	1940
Hamilton, May R., 165–20 Sanford Ave., Flushing, N. Y.	1937
Hand, Mrs. Louis E., 8061 Fairview St., Holmesburg, Philadelphia 36, Pa.	1939
Happel, William A., Scotch Plains, N. J.	1939
Harlow, Sarah H., 56 Hancock Ave., Yonkers 5, N. Y.	1940
Harvey, Anna L., 71–27 65th St., Glendale, N. Y.	1932
Hatfield, J. Horace, Scotch Plains, N. J.	1939
Hausman, Mrs. Leon A., 259 Harrison Ave., New Brunswick, N. J.	1944
Havender, James, Christopher Columbus High School, Astor & Golden Aves., New York, N. Y.	1947
Herkstroter, Merle, 61 Forster Ave., Valley Stream, N. Y.	1945
Hervey, Leon, 175 West 93rd St., New York, N. Y.	1939
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Jewett, Dorothy, 25 North Crescent, Maplewood, N. J.	1934
Keefe, Mary M., Biological Laboratory, Fordham University, New York 58, N. Y.	1946
Ketcham, Clara L., 314 East Columbia St., Hempstead, N. Y.	1946
Kilbourne, Frederick W., P.O. Box 514, Cheshire, Conn.	1941
Kinney, Mrs. Warren, Morristown, N. J.	1940
Kline, Adele L., 41 Eastern Pkway., Newark, N. J.	1935
Koch, Alexander, 131 Fort George Ave., New York 33, N. Y.	1947
Koeniger, Julius, 9134 Park Lane South, Woodhaven, N. Y.	1943
Koeniger, Mrs. Julius, 9134 Park Lane South, Woodhaven, N. Y.	1943
Labaugh, James M., 90 Bamford Ave., Hawthorne, N. J.	1941
Latham, Roy, Orient, New York	1940
Laughnan, John R., Dept. of Biology, Princeton University, Princeton, N. J.	1947
Lawton, R. M., 1215 Prospect Ave., Plainfield, N. J.	1946
Lawton, Mrs. Richard M., 1215 Prospect Ave., Plainfield, N. J.	1940
Leibersberger, Harry, 73–55 196th St., Flushing, N. Y.	1947
Leiser, Henry, 127 East 90th St., New York 28, N. Y.	1947
Levine, Moses N., University Farms Campus, St. Paul 1, Minn.	1941
Lichtenburg, Gertrude O., 55 Fabyan Place, Newark 8, N. J.	1941
Le Preaux, Mary A., 2525 Morris Ave., New York 58, N. Y.	1947
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McMillan, Janet, 264½ Garside St., Newark, N. J.	1946
Mack, Bertha, 4829–61st St., Woodside, N. Y.	1938
Mann, M. D., Jr., 625 Locust St., Roselle, N. J.	1940
Marlowe, Phyllis G., 739 West 186th St., New York 33, N. Y.	1947
Marsh, Mrs. Spencer Scott, Midwood Terrace, Madison, N. J.	1925
Marshall, Mary, 79 Western Ave., Morristown, N. J.	1946
Martin, Grace L., 3070 Hull Ave., New York 67, N. Y.	1947
Mee, John R., Box 147, Beechwood, New Jersey	1941
Metger, Minnie, 1335 College Ave., New York 56, N. Y.	1947
Moiles, Sophia M., 638 Luzerne St., Johnstown, Pa.	1947
Mutchler, Marjorie, 71 West 8th St., Bayonne, N. J.	1943
Nelson, Julia C., 126 West 74th St., New York 23, N. Y.	1935
Nihlewicz, M. B., 85–56 79th St., Woodhaven, L. I., N. Y.	1946

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Ober, Marion K., 7 Midland Ave., White Plains, N. Y. 1937
O'Blenis, Mrs. Peter M., 594 East 25th St., Paterson 4, N. J. 1941
Orr, Mrs. George P., Willowbrook Farm, Paoli, Pa. 1943
Otero, J. I., Institute of Tropical Agriculture, University of Puerto Rico, Mayaguez, P. R. 1945
Peloubet, S. W., 228 Sagamore Rd., Maplewood, N. J. 1935
Phillip, Gertrude, 241 East 79th St., New York 21, N. Y. 1947
Phillips, Eleanor, 544 Kerper St., Philadelphia 11, Pa. 1946
Plate, Emma, 344 Highwood Ave., Leonia, N. J. 1947
Pomeranz, Caroline, 2805 Grand Concourse, New York, N. Y. 1938
Radu, Gertrude N., 43–34 49th St., Long Island City 4, N. Y. 1941
Randolph, L. F., Dept. of Botany, College of Agriculture, Cornell University, Ithaca, N. Y. 1941
Redlefsen, Hanna, Montefiore Hospital, Gun Hill Road, New York, N. Y. 1938
Reid, A. D., 260 Boulevard, Mountain Lakes, N. J. 1946
Reid, Mrs. A. D., 260 Boulevard, Mountain Lakes, N. J. 1946
Richtberg, Viola, 2305 Andrews Ave., New York, N. Y. 1937
Roberts, Eleanor, 335 West 19th St., New York 11, N. Y. 1947
Rodda, John L., 242 Princeton Ave., Palmerton, Pa. 1932
Rogers, Margaret S., 20 Haslet Ave., Princeton, N. J. 1942
Ruggles, Mrs. Frank G., 10 Marion Ave., Millburn, N. J. 1937
Sanchez, Cecil, 240 East 106th St., New York 29, N. Y. 1947
Schatz, Albert, Sloan-Kettering Inst., 444 East 68th St., New York 21, N. Y. 1946
Schnitzer, Mrs. Albert, 922 Lakeside Place, Elizabeth 3, N. J. 1947
Secor, H. Mabel, 18 Hubert Place, New Rochelle, N. Y. 1937
Seemann, Frieda, 2995 Botanical Square, New York 58, N. Y. 1939
Shannon, Walter W., 106 Cabrinin Blvd., New York 33, N. Y. 1946
Shapley, Harry, 2710 Webb Ave., New York 63, N. Y. 1947
Silvers, Josephine, 17 Teneyck Ave., Valley Stream, N. Y. 1945
Smith, Edith L., 37 Colles Ave., Morristown, N. J. 1947
Smith, Lyman B., 228 Highland Ave., Winchester, Mass. 1938
Smith, May C., Canaan, Conn. 1938
Stanley, Phyllis, 641 Ridge St., Newark, N. J. 1941
Stephen, Frank, 421 New Jersey Ave., Brooklyn 7, N. Y. 1947
Stewart, J. A., Jr., 813 Centre St., Trenton 10, N. J. 1946
Stobaugh, Charlotte W., R.R. 2, Lakewood, N. J. 1947
Stoner, Mrs. C. Birch, Hobart Ave., Short Hills, N. J. 1943
Studley, Miriam V., 118 N. 19th St., East Orange, N. J. 1946
Sullivan, T. D., Biology Dept., Fordham University, New York 58, N. Y. 1946
Tainter, Grace, 161 Emerson Place, Brooklyn 5, N. Y. 1945
Taylor, Louise W., 2685 Boulevard, Jersey City, N. J. 1946
Thacher, Mrs. Alfred B., 486 Scotland Rd., South Orange, N. J. 1939
Thomson, Betty F., Connecticut College, New London, Conn. 1948
Timer, Julia, 97 Beech St., East Orange, N. J. 1944
Tolstoouhov, Alexander V., 24 Arden St., New York, N. Y. 1931
Tomkins, Elizabeth, 80 Lincoln Ave., Poughkeepsie, N. Y. 1929
Valli, Valentine F., 215 East 39th St., New York 16, N. Y. 1947
Van Saun, Frieda, Box 171, Midland Park, N. J. 1935
Vivian, Eugene Mc. V., 83 Sylvan St., Rutherford, N. J. 1941
Walter, Ernest, 166 North Mountain Ave., Montclair, N. J. 1941
Walton, Evelyn, Box 35 Campgaw, N. J. 1947
Warsley, Helen, 140 Sterling Ave., New York, N. Y. 1947
Wartenberg, Mrs. W. Stanley, 2652 East 18th St., Brooklyn 29, N. Y. 1941
Waterfall, Myrtle H., 175 Broadway, Passaic, N. J. 1933
Willett, Mrs. Merrill H., 210–21 29th Ave., Bayside, N. Y. 1940
Woodelton, Mrs. Roy, 454 Seventh St., Brooklyn, N. Y. 1925

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TAXONOMY, PHYLOGENY AND FLORISTICS

(see also under Genetics: **Olsson & Rufelt**; under General Botany: **Rickett**)

ALGAE

Chou, Ruth Chen-Ying. Pacific species of *Galaxaura*, II. Sexual types. Pap. Mich. Acad. **31**(1): 3–24. *pl. 1–13* + *f. 1–3.* [1948].

Habeeb, Herbert & Drouet, Francis. A list of freshwater algae from New Brunswick. Rhodora **50**: 67–71. Mr 1948.

Hollenberg, G. J. Notes on Pacific Coast marine algae. Madroño **9**: 155–162. Ja [Mr] 1948.

Peterson, Carroll J. A method for cytological investigation of algae. Trans. Ill. Acad. **40**: 57–59. *f. 1.* 1947 [Mr 1948].

Taylor, Wm. Randolph. Algae collected by the "Hassler," "Albatross" and Schmitt expeditions, III. Marine algae from Peru and Chile. Pap. Mich. Acad. **31**(1): 57–90. *pl. 1–14.* [1948].

FUNGI AND LICHENS

(see also under Morphology: **Nagel**)

Baxter, Dow V. Some resupinate polypores from the region of the Great Lakes. XVIII. Pap. Mich. Acad. **31**(1): 117–130. *pl. 1–5.* [1948].

Baxter, Dow V. Occurrence of fungi in the major forest types of Alaska. Pap. Mich. Acad. **31**(1): 93–115. *pl. 1–18* + *f. 1–7.* [1948].

Favret, Ewald A. Hallazgo de una nueva raza de *Erysiphe graminis hordei.* Revista Invest. Agr. [Buenos Aires] **1**: 237–240. 1947.

Johnson, T. A form of *Leptosphaeria avenaria* on wheat in Canada. Canad. Jour. Res. **C25**: 259–270. *f. 1–11.* 1947.

Lamb, I. Mackenzie. A monograph of the lichen genus *Placopsis* Nyl. Lilloa **13**: 151–288. *pl. 1–16* + *f. 1–7.* 29 D 1947.

Marchionatto, Juan B. Nota sobre tres especies de *Septoria* parasitas de las plantas. Revista Invest. Agr. [Buenos Aires] **1**: 233–235. *pl. 1.* 1947.

Negroni, P. & Daglio, C. A. N. Sobre el género *Nectaromyces.* Anal. Soc. Ci. Argent. **144**: 484–491. *f. 1–2.* 1947 [1948].

Singer, R. Contributions toward a monograph of the genus *Crepidotus.* Lilloa **13**: 59–95. *f. 1–5.* 29 D 1947.

Thirumalachar, M. J. Some new or interesting fungi. Bull. Torrey Club **75**: 175–177. Mr 1948.

Vallega, J. & Favret, E. A. Razas fisiologicas de *Puccinia graminis tritici* que atacan a *Triticum timopheevi.* Revista Invest. Agr. [Buenos Aires] **1**: 113–118. *pl. 1.* 1947.

BRYOPHYTES

Arzeni, Charles B. Some bryophytes of Coles and Clark Counties [Illinois]. Trans. Ill. Acad. **40**: 44–49. 1947 [Mr 1948].

Fulford, Margaret. Recent interpretations of the relationships of the Hepaticae. Bot. Rev. **14**: 127–173. Mr 1948.

Steere, William Campbell. The bryophyte flora of Michigan. Pap. Mich. Acad. 31(1): 33–56. 1945 [1948].

PTERIDOPHYTES

Butters, F. K. & Tryon, R. M. A fertile mutant of a *Woodsia* hybrid. Am. Jour. Bot. 35: 132. F [Mr] 1948.

Castellanos, A. & Capurro, R. H. Catálogo de los géneros de las plantas vasculares de la flora argentina. Pteridophyta. Lilloa 13: 289–309. 29 D 1947.

SPERMATOPHYTES

Allard, H. A. *Hibiscus syriacus*—totus albus in Virginia. Castanea 12: 115, 116. D 1947 [F 1948].

Allard, H. A. *Tragopogon pratensis* in West Virginia. Castanea 12: 115. D 1947 [F 1948].

Allard, H. A. *Vaccinium erythrocarpum*—What is the fruit color? Castanea 12: 117, 118. D 1947 [F 1948].

Allen, Carolina K. Lauraceae *In:* Woodson, Robert E. *et al.* Flora of Panama Part V fascicle 1. Ann. Mo. Bot. Gard. 35: 1–68. *f. 1–42.* 22 Mr 1948.

Ames, O. The identity of *Dendrobium "Guadalcanal."* Am. Orchid Soc. Bull. 16: 643–646. 1 D 1947.

Amshoff, G. J. H. Dioscoreae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau —II. Bull. Torrey Club 75: 209. Mr. 1948.

Amshoff, G. J. H. Marantaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—II. Bull. Torrey Club 75: 210, 211. Mr 1948.

Amshoff, G. J. H. Haemodoraceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—II. Bull. Torrey Club 75: 209. Mr 1948.

Amshoff, G. J. H. Zingiberaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—II. Bull. Torrey Club 75: 209, 210. Mr 1948.

Amshoff, G. J. H. Musaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau —II. Bull. Torrey Club 75: 209. Mr 1948.

Arens, Karl. Contribuição para o conhecimento das incrustações calcáreas de *Nitella.* Bol. Mus. Nac. [Rio de Janeiro] II. 6: 1–15. *f. 1–6.* 31 My 1946.

Ball, Carleton R. *Salix petiolaris* J. E. Smith: American, not British. Bull. Torrey Club 75: 178–187. Mr 1948.

Ballard, F. *Agastache Mexicana* [from Mexico]. Bot. Mag. 164: *pl. 9685* + *f. 1.* 23 F 1948.

Barneby, R. C. Pugillus *Astragalorum* IX: Novelties in *Batidophaca* Rydb. Leafl. West. Bot. 5: 82–89. 16 F 1948.

Barrett, Mary F. *Ficus* in Florida—II. African species. Am. Midl. Nat. 39: 188–219. Ja [Mr] 1948.

Beetle, A. A. New records for *Scirpus.* Leafl. West. Bot. 5: 89, 90. 16 F 1948.

Boivin, Bernard. *Thalictrum* in West Virginia. Castanea 12: 116. D 1947 [F 1948].

Brown, Clair A. Louisiana trees and shrubs. La. Forest. Comm. Bull. 1: *i–x* + 1–262. *front.* + *f. 1–147.* 1945.

Burcham, L. T. Observations on the grass flora of certain Pacific Islands. Contr. U. S. Nat. Herb. 30[2]: 405–447. *pl. 1–7* + *f. 1–4.* [Mr] 1948.

Condit, Ira J. The fig. *i–xviii* + 1–222. *f. 1–27* + *tables 1–12.* Chron. Bot. Co. Waltham, Mass. 1947.

Cory, V. L. Botanizing with "Marcus E. Jones, A. M." in Texas. Field & Lab. **16:** 45–61. *port.* Ja [1 Mr] 1948.

Cory, V. L. A new *Palafoxia* [*bella*] from the Edwards Plateau of Texas. Field & Lab. **16:** 61–64. Ja [1 Mr] 1948.

Croizat, Leon. *Euphorbia maculata:* a rejoinder. Bull. Torrey Club **75:** 188. Mr 1948.

Croizat, Leon. A study in the Celastraceae. Siphonodonoideae subf. nov. Lilloa **13:** 31–43. *f. 1–8.* 29 D 1947.

Cronquist, Arthur. A revision of the *Oreastrum* group of *Aster.* Leafl. West. Bot. **5:** 73–82. 16 F 1948.

Dansereau, Pierre. The distribution and structure of Brazilian forests. Forestry Chron. **23:** 261–277. D 1947.

Dansereau, Pierre & Raymond, Marcel. Botanical excursions in Quebec Province: Montreal-Quebec-Gaspé Peninsula. Bull. Service Biog. **2:** 1–20. F 1948.

Fanshawe, D. B. Studies of the trees of British Guiana, III, IV, V. Trop. Woods **93:** 1–28. 1 Mr 1947.

Fernald, M. L. A Virginian *Peltandra.* Rhodora **50:** 56–59. Mr 1948.

Flint, Joanne & Hodgon, A. R. Another New Hampshire station for *Subularia* [*aquatica*]. Rhodora **50:** 72. Mr 1948.

Fuller, George D. Additions to the flora of Sangamon County, Illinois. Trans. Ill. Acad. **40:** 50, 51. 1947 [Mr 1948].

Fuller, George D. A new *Collinsia* in Illinois. Am. Midl. Nat. **38:** 246. Ja [Mr] 1948.

Glassman, S. F. A survey of the plants of Guam. Jour. Arnold Arb. **29:** 169–185. *pl. 1, 2.* 15 Ap 1948.

Gleason, H. A. *Blephilia ciliata* (L.) Benth. Rhodora **50:** 53–55. Mr 1948.

Gray, Netta E. & Buchholz, John T. A taxonomic revision of *Podocarpus.* III. The American species of *Podocarpus*: Section *Polypodiopsis.* Jour. Arnold Arb. **50:** 117–122. *pl. 5.* 15 Ap 1948. IV. The American species of Section *Eupodocarpus,* Subsections C and D. 123–151. *pl. 1–8.*

Hawkes, J. G. Potato collecting expeditions in Mexico and South America. II. Systematic classification of the collections. 1–142. *pl. 1, 2* + *f. 1–92.* Imp. Bureau Pl. Breed. & Genet. 1944.

Hermann, F. J. A new species of *Carex* from Tennessee. Castanea **12:** 113–115. D 1947 [F 1948].

Hermann, Frederick J. Studies in *Lonchocarpus* and related genera, III: *Humboldtiella* and *Callistylon.* Jour. Wash. Acad. **38:** 72–75. 15 F 1948.

Hoehne, F. C. Barbosellae Brasiliae australis novae varietates communationesque in ipsius specierum nomenclatione. Arq. Bot. Est. S. Paulo II. **2:** 74–76. *pl. 19–24.* 1947.

Hoehne, F. C. Novas espécies e contribuições para o conhecimento do género *Aristolochia* na América do Sul. Arq. Bot. Est. S. Paulo II. **2:** 95–103. *pl. 32–39.* 1947.

Hoehne, F. C. Observações e illustrações para duas espécies de *Pleurothallis.* Arq. Bot. Est. S. Paulo II. **2:** 94. *pl. 31* + *f. 2, 3.* 1947.

Hoehne, F. C. Presente estado da subsecção *Holochila* da secção *Aulizeum* do gènero *Epidendrum*, no Brazil. Arq. Bot. Est. S. Paulo II. **2:** 77–87. *pl. 25.* 1947.

Hoehne, F. C. Quatro novas espécies de Orchidaceas do Brasil austro-oriental. Arq. Bot. Est. S. Paulo II. **2:** 88–91. *pl. 26–28.* 1947.

Hoehne, F. C. Reajustamento de algumas espécies de Maxillaricas do Brasil, com a criação de dois novos géneros para elas. Arq. Bot. Est. S. Paulo II. **2:** 65–73. *pl. 16.* 1947.

Howell, John Thomas. Concerning a California cudweed. Leafl. West. Bot. **5:** 90, 91. 16 F 1948.

Howell, John Thomas. A new California *Castilleja.* Leafl. West. Bot. **5:** 91, 92. 16 F 1948.

Hultén, Eric. Flora of Alaska and Yukon—VI. Dicotyledoneae Rosales (Rosaceae). Lunds Univ. Årskk. II. Sect. 2. **42:** 981–1066. *f. 743–805.* 1946.

Johnston, Ivan M. Noteworthy species from Mexico and adjacent United States, II. Jour. Arnold Arb. **29:** 193–197. 15 Ap 1948.

Jones, George Neville. A revised checklist of the vascular plants of the University of Illinois woodlands. Trans. Ill. Acad. **40:** 52–56. 1947 [Mr 1948].

Jonker, F. P. Burmanniaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau —II. Bull. Torrey Club **75:** 211, 212. Mr 1948.

Jonker, F. P. Remarks on the genera *Stahelia* and *Tapeinostemon* (Gentianaceae). Rec. Trav. Bot. Néerl. **41:** 145–149. 1946–1948 [Ja 1948].

Kausel, Eberhard. Notas mirtalógicas. Lilloa **13:** 125–149. *f. 1–3.* 29 D 1947.

Kelso, Leon. Embryo taxonomists. Biol. Leafl. **40:** 1–4. 27 F 1948.

Krukoff, B. A. & Monachino, J. Supplementary notes on the American species of *Strychnos*—IV. Bol. Tec. Inst. Agron. Norte [Belém] **11:** 1–15. Je 1947. V. **12:** 1–16. Au 1947.

Leite, José Eugenio. Uma nova *Pleurothallis* de campos de Jordão, S. Paulo. Arq. Bot. Est. S. Paulo II. **2:** 93. *pl. 3 + f. 1.* 1947.

Little, Elbert L. New species of trees from western Ecuador. Jour. Wash. Acad. **38:** 87–105. *f. 1–19.* 15 Mr 1948.

Luther, Hans. Morphologische und systematische Beobachtungen an Wasserphanerogamen. [Various N. Am. species.] Acta Bot. Fenn. **40:** 1–28. *f. 1–79.* 1947.

Luther, Hans. *Typha angustifolia* [L.] × *latifolia* L. (*T. glauca* Godr.) i Ostfennoskandien. [Notes on N. Am. material]. Mem. Soc. Faun. Fl. Fenn. **23:** 66–75. *f. 1.* 1946–1947.

Maguire, Bassett. A new *Licania* from the Amazon Basin. Trop. Woods **73:** 29, 30. *f. 1.* 1 Mr 1948.

Manning, Wayne E. A hybrid between shagbark and bitternut hickory in southeastern Vermont. Rhodora **30:** 60–62. Mr 1948.

Martinez Crovetto, Raul. La naturalizacion de *Acacia melanoxylon* en Balcarce (Provincia de Buenos Aires). Revista Invest. Agr. [Buenos Aires] **1:** 101, 102. *pl. 1.* 1947.

Matthews, Oliver V. A possible record of *Quercus Morehus* in Oregon. Madroño **9:** 168. Ja [Mr] 1948.

Merrill, E. D. *Neolitsea* (Bentham) Merrill, nomen conservandum propositum. Jour. Arnold Arb. **29:** 198–201. 15 Ap 1948.

Merrill, E. D. Nomenclatural notes on Rafinesque's published papers 1804–1840. Jour. Arnold Arb. **29**: 202–214. 15 Ap 1948.

Merrill, E. D. An overlooked Flora indica. Jour. Arnold Arb. **29**: 186–192. *1 pl.* 15 Ap 1948.

Merrill, E. D. & Perry, L. M. Notes on some Papuan collections of Mary Strong Clemens. Jour. Arnold Arb. **29**: 152–168. 15 Ap 1948.

Meyer, Teodoro. Apocináceas argentinas I. *Forsteronia* y *Mesechites.* Lilloa **13**: 45–48. *map + f. 1–8.* 29 D 1947.

Meyer, Teodoro. Asclepiadaceae argentinenses novae aut criticae III. Lilloa **13**: 23–29. *pl.* [*1*] *2 + f. 1–3.* 29 D 1947.

Meyer, Teodoro. Las Sapotáceas argentinas. Lilloa **13**: 97–124. *pl. 1, 2 + f. 1–10 + maps 1, 2.* 29 D 1947.

Moldenke, Harold N. Contributions to the flora of extra-tropical South America X. Lilloa **13**: 5–15. 29 D 1947.

Moldenke, Harold N. Eriocaulaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau II. Bull. Torrey Club **75**: 194–203. Mr 1948.

Moul, Edwin T. A dangerous woody *Polygonum* in Pennsylvania. Rhodora **50**: 64–66. Mr 1948.

Pilger, R. Über einige Gramineen aus Südamerika. Bot. Jahrb. **73**: 99–105. 10 Ja 1943.

Porsild, A. E. The genus *Dryas* in North America. Canad. Field-Nat. **61**: 175–192. *pl. 1, 2 + f. 1–4.* 1947.

Porter, C. L. Contributions toward a flora of Wyoming. A Gazetteer for botanical collections. Rocky Mt. Herb. [Univ. Wyo.] Leafl. **17**: 1–27. 5 Ja 1948 [Hektog.].

Porter, C. L. Contributions toward a flora of Wyoming. [Typhaceae]. Rocky Mt. Herb. [Univ. Wyo.] Leafl. **18**: 1, 2. 10 F 1948 [Hekto.].

Ragonese, Arturo E. & Castiglioni, Julio A. Nueva especie del género *Schinopsis* y area geográfica de las especies Argentinas. Revista Invest. Agr. [Buenos Aires] **1**: 93–100. *pl. 1–5 + map.* 1947.

Ragonese, Arturo E. & Martinez Crovetto, R. Plantas indígenas de la Argentina con frutos o semillas comestibles. Revista Invest. Agr. [Buenos Aires] **1**: 147–216. *f. 1–11.* 1947.

Rollins, Reed C. Cruciferae. *In:* Woodson, Robert E. *et al.* Flora of Panama Part 5 fascicle 1. Ann. Mo. Bot. Gard. **35**: 99–106. *f. 52, 53.* 22 Mr 1948.

Rollins, Reed C. On two perennial caespitose Lepidiums of western North America. Madroño **9**: 162–165. *pl. 22.* Ja [Mr] 1948.

Runyon, R. Vernacular names of plants indigenous to the lower Rio Grande valley of Texas; a contribution to the knowledge of the flora of the lower Rio Grande valley of Texas. *i–viii,* 1–24. *ill.* Brownsville News Publ. Brownsville, Texas. 1947.

Sandwith, N. Y. *Serjania reticulata.* [from central and southern Brazil, Amazonian Bolivia, Northern Argentina]. Bot. Mag. **164**: *pl. 9686 + f. 1, 2.* 23 F 1948.

Schlitter, Jakob. Monographie der Liliaceen-gattung *Dianella* Lam. Mitt. Bot. Mus. Zürich **163**: 1–283. *pl. 1–35.* O 1940.

Schoenbeck, E. *Houstonia minima* in Peoria County [Illinois]. Trans. Ill. Acad. **40**: 60. 1947 [Mr 1948].

Schweinfurth, Charles. Orchidaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—II. Bull. Torrey Club **75**: 212–230. *f. 15–17.* Mr 1948.

Sealy, J. Robert. *Linanthus montanus* [from California]. Bot. Mag. **164:** *pl. 9688.* 23 F 1948.

Sealy, J. Robert. *Romanzoffia unalaschcensis* [from eastern Aleutian Islands and Alaska peninsula]. Bot. Mag. **164:** *pl. 9683B* + *f. 1.* 23 F 1948.

Shinners, Lloyd H. The vetches and pea vines (*Vicia* and *Lathyrus*) of Texas. Field & Lab. **16:** 18–29. Ja [Mr] 1948.

Smith, Lyman B. Bromeliaceae [of Guiana]. *In:* Maguire, B. *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—II. Bull. Torrey Club **75:** 205–208. *f. 14.* Mr 1948.

Standley, Paul C. & Barkley, Fred A. Noteworthy South American plants, I and II. Madroño **9:** 149–155. *pl. 20, 21.* Ja [Mr] 1948.

Suessenguth, K. Einige neue Gattungen und Arten der Cyperaceae aus Südamerika. Bot. Jahr. **73:** 113–125. *pl. 9, 10* + *f. 1–7.* 18 Je 1943.

Suessenguth, Karl. Neue Pflanzen aus Costa Rica, insbesondere vom Chirripó grande 3837m. Bot. Jahrb. **72:** 270–302. *pl. 1–4.* 30 Ja 1942.

Turrill, W. B. *Silene Hookeri* [from Oregon]. Bot. Mag. **164:** *pl. 9680* + *f. 1.* 23 F 1948.

Wagner, Fred H. The bur clovers (*Medicago*) of Texas. Field & Lab. **16:** 3–7. *1 pl.* Ja [Mr] 1948.

Waterfall, U. T. A new species of *Euphorbia* from Oklahoma. Rhodora **50:** 63, 64. Mr 1948.

Williams, L. O. & Hoehne, F. C. Uma nova espécie de *Phymatidium* do Brasil. Arq. Bot. Est. S. Paulo II. **2:** 92. *pl. 30.* 1947.

Winterringer, Glen. The Acanthaceae of Illinois. Trans. Ill. Acad. **40:** 73–78. 1947 [Mr 1948].

Woodson, Robert E. *et al.* Hernandiaceae, Papaveracea, Capparidaceae. *In:* Flora of Panama Part 5 fascicle 1. Ann. Mo. Bot. Gard. **35:** 68–99. *f. 43–51.* 22 Mr 1948.

PALEOBOTANY

Arnold, Chester A. Some cutinized seed membranes from the coal-bearing rocks of Michigan. Bull. Torrey Club **75:** 131–146. *f. 1–17.* Mr. 1948.

Hirmer, Max. Forschungsergebnisse der Paläobotanik auf dem Gebiet der Kanophytischen Floren. Bot. Jahrb. **72:** 347–563. *pl. 8–20* + *f. 1–44.* 23 O 1942.

Schopf, James M. Should there be a living *Metasequoia?* Science **107:** 344, 345. 2 Ap 1948.

ECOLOGY AND PLANT GEOGRAPHY

(see also under General Botany: **Anderson**)

Dansereau, Pierre. Zonation et succession sur la restinga de Rio de Janeiro. I. Halosère. Revue Canad. Biol. **6:** 448–477. *f. 1–13.* 1947.

Detling, LeRoy E. Environmental extremes and endemism. Madroño **9:** 137–149. *f. 1–7* + *tables 1–3.* Ja [Mr] 1948.

Fuller, Harry J. Carbon dioxide concentration of the atmosphere above Illinois forest and grassland. Am. Midl. Nat. **39:** 247–249. *tables 1–6.* Ja [Mr] 1948.

Hanes, Clarence R. Observances on the habits of some of the native plants of Kalamazoo County, Michigan. Pap. Mich. Acad. **31**(1): 25–31. 1947 [1948].

Marr, John W. Ecology of the forest-tundra ecotone on the east coast of Hudson Bay. Ecol. Monogr. **18:** 117–144. *f. 1–29* + *tables 1, 2.* Ja [Mr] 1948.

Moss, E. H. & Campbell, J. A. The fescue grassland of Alberta [Canada]. Canad. Jour. Res. C **25:** 209–227. *f. 1–4.* 1947.

Rachid, Mercedes. Transpiração e sistemas subterrâneos de la vegetação de verão dos campos cerrados de Emas. Univ. S. Paulo Fac. Filos. Ci. Letr. Bol. Bot. **5:** 5–129. *pl. 1–8 + f. 1–66.* 1947.

Sibert, Marvin. The control of weeds on a typical prairie farm. Trans. Ill. Acad. **40:** 61–65. *f. 1–3.* 1947 [Mr 1948].

Tryon, E. H. Effect of charcoal on certain physical, chemical, and biological properties of forest soils. Ecol. Monogr. **18:** 81–115. *f. 1–17 + tables 1–19.* Ja [Mr] 1948.

PHYTOPATHOLOGY

(see also under Physiology: **Sherwin** et al.)

Afanasiev, M. M. The relation of six groups of fungi to seedling diseases of sugar beets in Montana. Phytopathology **38:** 205–212. *table 1.* Mr 1948.

Brierley, Philip & Smith, Floyd F. Cana mosaic in the United States. Phytopathology **38:** 230–234. *f. 1 + table 1.* Mr 1948.

Cochrane, Vincent W. The role of plant residues in the etiology of root rot. Phytopathology **38:** 185–196. *f. 1, 2 + tables 1–3.* Mr 1948.

El-Helaly, A. F. The prevention of black stem of wheat. Phytopathology **38:** 161–184. *f. 1–4 + tables 1–15.* Mr 1948.

Fulton, Joseph P. Infection of tomato fruits by *Colletotrichum phomoides.* Phytopathology **38:** 235–246. *f. 1–4 + tables 1, 2.* Mr 1948.

Jeffers, W. F. & Woods, M. W. Field studies on spread of the mild streak disease of black respberries. Phytopathology **38:** 222–226. *f. 1 + tables 1, 2.* Mr 1948.

Kendrick, J. B. & Walker, J. C. Anthracnose of tomato. Phytopathology **38:** 247–260. *f. 1–6 + tables 1–4.* Mr 1948.

Linn, M. B. & Newhall, A. G. Comparison of two methods of pelleting onion seed in the control of smut. Phytopathology **38:** 218–221. *f. 1 + tables 1, 2.* Mr 1948.

Lorenz, Polland C. A new leaf disease of *Hevea* in Peru. Jour. Forest. **46:** 27–30. *f. 1–3.* Ja 1948.

Luttrell, E. S. *Botryosphaeria ribis* perfect stage of the *Macrophoma* causing ripe rot of muscadine grapes. Phytopathology **38:** 261–263. *f. 1.* Mr 1948.

Mendez, Luiz O. T. O superbrotamento da seringueira *Hevea Brasiliensis* Muell. Arg. Bol. Tec. Inst. Agron. Norte [Belém] **5:** 1–12. 31 Ja 1946.

Price, W. C. & Holt, Betty R. Kentucky Wonder bean plants as hosts for measuring southern bean mosaic virus activity. Phytopathology **38:** 213–217. *f. 1 + tables 1, 2.* Mr 1948.

Schneider, Henry. Susceptibility of guayule to *Verticillium* wilt and influence of soil temperature and moisture on development of infection. Jour. Agr. Res. **76:** 129–143. *f. 1–4 + tables 1, 2.* Mr 1948.

Severin, Henry H. P. Location of curly-top virus in the beet leafhopper, *Eutettix tenellus.* Hilgardia **17:** 545–551. *f. 1–3 + table 1.* O 1947.

Severin, Henry H. P. Viruses that induce breaking in color of flower petals in pansies and violas. Hilgardia **17:** 577–588. *pl. 1–6 + f. 1.* N 1947.

Severin, Henry H. P. & Drake, Roger M. Weeds experimentally infected with beet-mosaic virus. Hilgardia **17:** 569–571. *pl. 1, 2.* O 1947.

Severin, Henry H. P. & Little, Donald H. Spinach yellow dwarf. Hilgardia **17:** 555–561. *pl. 1, 2 + table 1.* O 1947.

Woodward, Carol H. The elms of America . . . what is to be their fate? Jour. N. Y. Bot. Gard. **49**: 49–69. *8 f.* Mr 1948.

MORPHOLOGY
(including anatomy & cytology in part)
(see also under Spermatophytes: **Luther**)

Bailey, I. W. & Swamy, B. G. L. *Amborella trichopoda* Baill. A new type of vesselless dicotyledon. Jour. Arnold Arb. **29**: 215– 15 Ap 1948.

Cheadle, Vernon I. Observations on the phloem in the Monocotyledoneae. II. Additional data on the occurrence and the phylogenetic specialization in the structure of the sieve tubes in the metaphloem. Am. Jour. Bot. **35**: 129–131. *tables 1–3.* F [Mr] 1948.

Cox, Hiden T. Studies in the comparative anatomy of the Ericales. I. Ericaceae —subfamily Rhododendroideae. Am. Midl. Nat. **39**: 220–245. *f. 1–6.* Ja [Mr] 1948.

Cozzo, Domingo. Anatomía del leño secundario de *Tricomaria usillo* Gill. ex H. et A. Lilloa **13**: 17–21. *1 pl.* 29 D 1947.

Nagel, Lillian. Volutin. Bot. Rev. **14**: 174–184. Mr 1948.

Sterling, Clarence. Gametophyte development in *Taxus cuspidata.* Bull. Torrey Club **75**: 147–165. *f. 1–28.* Mr 1948.

Swamy, B. G. L. Contributions to the life history of a *Cycas* from Mysore (India). Am. Jour. Bot. **35**: 77–88. *f. 1–38.* F [Mr] 1948.

GENETICS
(including cytogenetics)

Jones, D. F. The nature of gene action as shown in cell-limited and cell-diffusible gene products. Proc. Nat. Acad. **33**: 363–365. D 1947.

Olsson, Gosta & Rufelt, Brita. Spontaneous crossing between diploid and tetraploid *Sinapis alba.* Hereditas **34**: 351–365. *f. 1–3 + tables 1–4.* 1948.

Schnack, Benno & Fernandez, Onofre. Nuevos resultados en la genética de los pigmentos florales del aleli. Revista Invest. Agr. [Buenos Aires] **1**: 103–111. 1947.

Smith, Paul G. Brown, mature-fruit color in pepper (*Capsicum frutescens*). Science **107**: 345, 346. 2 Ap 1948.

Westergaard, M. The relation between chromosome constitution and sex in the offspring of triploid *Melandrium.* Hereditas **34**: 257–279. 1948.

PLANT PHYSIOLOGY

Bondar, Gregorio. Arvores lactíferas na Bahia e nova industria extrativa de gomas. Bol. Inst. Cent. Fom. Econ. Bahia **16**: 1–43. *f. 1–19.* 1948.

Bonner, Walter & Bonner, James. The role of carbon dioxide in acid formation by succulent plants. Am. Jour. Bot. **35**: 113–117. *f. 1 + tables 1–4.* F [Mr] 1948.

Chapman, H. D., Brown, S. M. & Rayner, D. S. Effects of potash deficiency and excess on orange trees. Hilgardia **17**: 619–641. *pl. 1–6 + tables 1–10.* D 1947.

Dimmock, Isabel. Phosphorus deficiency in relation to the nitrate reduction test. Canad. Jour. Res. C **25**: 271–273. 1947.

Ennis, W. B. Some cytological effects of O-isopropyl N-phenyl carbamate upon *Avena.* Am. Jour. Bot. **35**: 15–21. *f. 1–24.* Ja [18 F] 1948.

Gray, Reed & Bonner, James. An inhibitor of plant growth from the leaves of *Encelia farinosa.* Am. Jour. Bot. **35**: 52–57. *f. 1–4 + tables 1–4.* Ja [18 F] 1948.

Krotkov, G. & Barker, H. A. Utilization of acetate by tobacco leaves, as determined with C^{14}. Am. Jour. Bot. **35**: 12–15. *table 1.* Ja [18 F] 1948.

Mors, Walter B. A hemicelulose das sementes de *Hymenaea parvifolia* Huber e seu emprego na cremagem do latex de seringueira. Bol. Tec. Inst. Agron. Norte [Belém] **6**: 1–42. Ap 1946.

Perlman, D. On the nutrition of *Memnoniella echniata* and *Stachybotrys atra.* Am. Jour. Bot. **35**: 36–41. *tables 1–7.* Ja [18 F] 1948.

Sherwin, Helen S., Lefébvre, C. L. & Leukel, R. W. Effect of seed treatment on the germination of soybeans. Phytopathology **38**: 197–204. *f. 1 + tables 1–6.* Mr 1948.

Spoerl, Edward. Amino acids as sources of nitrogen for orchid embryos. Am. Jour. Bot. **35**: 88–95. *f. 1–5 + tables 1, 2.* F [Mr] 1948.

Stewart, W. S., Bonner, J. & Hummer, R. W. Yield, composition and other latex characteristics of *Cryptostegia grandiflora.* Jour. Agr. Res. **76**: 105–127. *tables 1–17.* Mr 1948.

Thimann, Kenneth V. & Behnke, Jane. The use of auxins in the rooting of woody cuttings. Maria Moors Cabot Found. Publ. **1**: 1–272. 1947 [1948].

Wallihan, E. F. The influence of aluminum on the phosphorus nutrition of plants. Am. Jour. Bot. **35**: 106–112. *f. 1 + tables 1, 2.* F [Mr] 1948.

Went, F. W. & Carter, Marcella. Growth response of tomato plants to applied sucrose. Am. Jour. Bot. **35**: 95–106. *f. 1–9 + tables 1–10.* F [Mr] 1948.

Winokur, Morris. Growth relationships of *Chlorella* species. Am. Jour. Bot. **35**: 118–129. *f. 1–2B + tables 1–4.* F [Mr] 1948.

GENERAL BOTANY
(Including Biography)

Anderson, James R. Some effects of glaciation upon agricultural productivity in Morgan County [Indiana]. Proc. Ind. Acad. **56**: 174–181. *f. 1–3.* 1946 [1947].

Asmous, Vladimir C. Fontes historiae botanicae rossicae. Chron. Bot. **11**: 88–118. *illust.* 1947 [1948].

Denny, Margaret. Linnaeus and his disciple in Carolina. Isis **38**: 161–174. F 1948.

Geiser, S. W. Biological publications in the Second Texas Academy of Science Proceedings, 1892–1912. Field & Lab. **16**: 8–18. Ja [Mr] 1948.

Kriebel, Ralph M. Indiana's changing landscape. Proc. Ind. Acad. **56**: 95–105. 1946 [1947].

Rickett, H. W. Citation of botanical references. Bull. Torrey Club **75**: 166–171. Mr 1948.

Rickett, H. W. Citation of authors' names in taxonomy. Bull. Torrey Club **75**: 172–174. Mr 1948.

Sauer, Carl O. Environment and culture during the last deglaciation. Proc. Am. Philos. Soc. **92**: 65–77. 1948.

Senn, Harold A. A bibliography of Canadian plant geography VIII. The period 1936–1940. Trans. Roy. Canad. Inst. **26**[2]: 153–344. 1947.

Spooner, Harry L. Virginius H. Chase, Peoria botanist. Trans. Ill. Acad. **40**: 67–72. *2 ports.* 1947 [Mr 1948].

Stehlé, H. Les reliques végétales de la Réserve Caraibe de la Dominique (Antilles anglaises). Bull. Soc. Bot. Fr. **74**: 158–166. Mr-Je 1947.

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PROEMBRYO AND EARLY EMBRYOGENY IN TAXUS CUSPIDATA

CLARENCE STERLING

Until recently, the phylogenetic theories developed in conifer embryogeny by the investigations of Buchholz (1918, 1920, 1929, 1931, 1936, etc.) and his students have been unchallenged. In an extensive critique of the ideology of the Buchholz concepts, Thomson (1945) has also called attention to the criticisms of Goebel (1933) and Doyle and Looby (1939). Likewise, Allen (1946) has suggested a divergent view of the evolutionary status of "cleavage polyembryony."

In considering nutritional factors in embryogeny, Thomson (1945) has stressed the need for an experimental approach. In addition, in testing any phylogenetic theory, it is imperative to gather observational data from all forms. This necessitates a reinvestigation of older materials as well as comparative studies in unknown genera and species. Continuing the study begun by the author (Sterling 1948), the present paper considers the development of the proembryo and early stages in embryogeny in *Taxus cuspidata*. The terminology regarding stages in embryo development is essentially that employed by Allen (1946) while Buchholz' (1929) definitions were followed for specific structures in the young embryo.

Materials and Methods. The sectioned material used in this investigation was collected and prepared as described earlier (Sterling 1948). Embryos were dissected out in 1946 and 1947 according to the method outlined by Buchholz (1938) and were mounted in balsam after staining in acid fuchsin and fast green. Drawings were made by camera lucida and microprojection.

Fertilization. The process of fertilization in the conifers has been particularly studied in the Pinaceae, in which morphological sequences appear to occur more or less synchronously in individuals of a particular species at given sites. (In families in which chronological precision is less marked, detailed descriptions of fertilization are less frequent.) Most attention has been focused upon the behavior of the groups of male and female chromosomes during the process. Recently, Allen (1946) has contributed observations on fertilization in *Pseudotsuga* and analyzed some of the conflicting opinions on the program of events. In this paper, it is not intended to review the various studies on the act of fertilization. Owing to the lack of critical material showing stages between entry of the male gamete and the telophase of the first zygotic division, the present study cannot contribute to the question of chromosome behavior.

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As described earlier (Sterling 1948), the functional sperm nucleus comes into contact with the egg nucleus and sinks into it. The fusing nuclei move to the base of the archegonium with the male nucleus still lying in an indentation of the female (fig. 7). These nuclei, as well as the early proembryonic nuclei, are embedded in a very grandular, deeply-staining mass of cytoplasm occupying the base of the egg. This dense cytoplasm differs from that about the unfertilized egg nucleus in structure and staining quality and may contain a portion of the cytoplasm of the sperm cell.

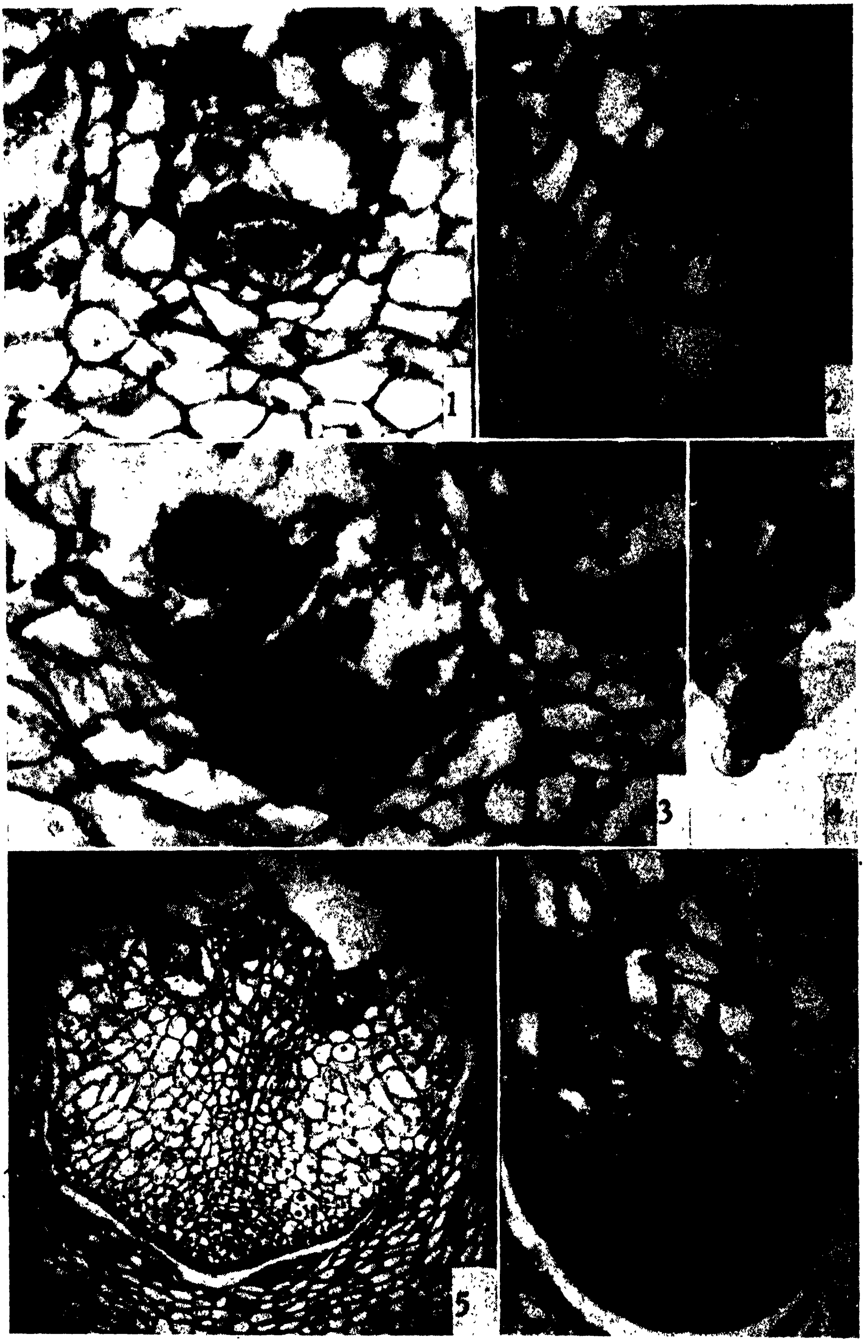
The question whether complete fusion of nuclear substance takes place must remain unanswered. Two preparations were found in which there appeared to be a single resting nucleus at the base of the egg. All other material at this stage showed either the two fusing nuclei or the telophase of the first division (fig. 1). With these as the only phases found in this critical period, it is not difficult to accept the resting fusion nucleus as a normal temporary condition of the zygote, as was found by Jäger (1899). A resting zygote is also described in *Juniperus* (Nichols 1910), *Tetraclinis* (Saxton 1913), *Sequoiadendron* (Looby & Doyle 1937), *Seqüoia* (Lawson 1904a), *Cryptomeria* (Lawson 1904b), *Podocarpus* (Looby & Doyle 1944), and *Saxegothaea* (Looby & Doyle 1939). However, more closely spaced stages are needed to determine chromosome behavior at fertilization and the normality of a fusion nucleus in *Taxus*.

The fact that the number of pollen tubes is always equal to or greater than the number of zygotes constitutes indirect evidence that only one of the two sperm cells of a pollen tube is functional. In addition, it is often possible to recognize three supernumerary nuclei in the upper part of the fertilized egg, these nuclei being presumably the second sperm nucleus and the two vegetative nuclei from the pollen tube.

Free Nuclear Stages of the Proembryo. The first division of the zygote was found as early as May 12 in 1946. In this division, the spindle is transverse to the long axis of the archegonium (fig. 1). The two sporophytic nuclei are not separated by a cell wall, and they usually lie close together in the dense mass of zygotic cytoplasm in the base of the egg. On occasion, the first division may take place in the center of the archegonium, before the zygote has reached the base (also Sugihara 1945). Thus the first two nuclei may be

Explanation of figures 1–6

All figures are longisections, with micropyle toward top of page. FIG. 1. Archegonium showing spindle of first sporophytic division. Note density of zygotic cytoplasm. ×300. FIG. 2. Binucleate proembryo near center of egg cell. ×300. FIG. 3. Archegonium in center shows portion of 4-nucleate proembryo. At right is another section of the egg in figure 1. ×300. FIG. 4. Multicellular embryonic group at tip of an isolated suspensor cell in same embryo system with embryo of figure 35. ×150. FIG. 5. Megagametophyte with proembryo in archegonium at right. Note differentiation in central axis and at base of prothallus. ×75. FIG. 6. Median section of free embryo apex, showing multicellular massive apex prior to differentiation of stele promeristem. ×300.



found in the center of the egg (figs. 2, 8) but soon move to its base. The second division in the proembryo often occurs in the same transverse plane, at right angles to the first, producing four nuclei symmetrically disposed in one tier which is perpendicular to the long axis of the archegonium. Sometimes this arrangement may vary, so that the nuclei lie in a single row, partly in the base and partly along the lower side of the archegonium (fig. 3). However, these other instances of the 4-nucleate stage occur less frequently.

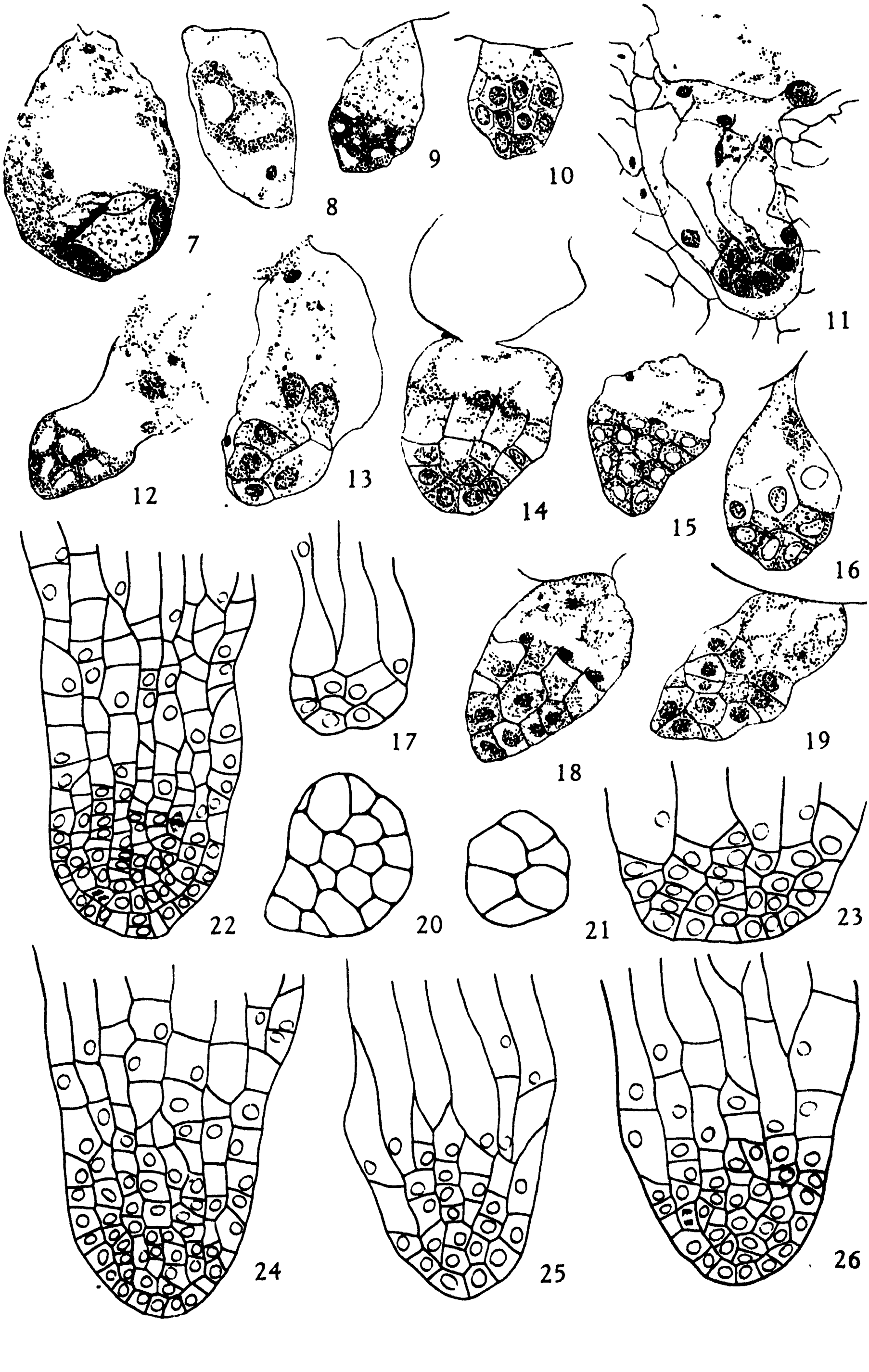
The following divisions result in the irregular dispersal of the nuclei in the proembryonic cytoplasm. No walls are produced in these early divisions, and spindle fibers are usually not observable after the nuclei have been reconstituted. When eight free nuclei have been formed, there is little uniformity in their position. They appear to be randomly distributed in the egg base. In one case, the eight nuclei and the accompanying cytoplasm extended along one side of the archegonium from its base to a point near the neck. At this stage the nuclei are considerably smaller than those of the binucleate stage, a phenomenon also described in other conifers. The nuclei become still smaller after the next free nuclear division, which gives rise to 16 nuclei. These, with their associated cytoplasm, occupy the lower one-third of the archegonium, and their arrangement is again quite variable.

Cellular Stages of the Proembryo. After the production of 16 nuclei, walls are usually formed. There is no gradual retention of initially ephemeral cell walls with each successive nuclear division, as Chamberlain (1910) found in the proembryo of *Dioon*, nor were the transitory cell plates mentioned by Jäger (1899) seen during earlier divisions. Most preparations show the new walls forming on fibers which extend between all the nuclei, as though consequent on the fourth nuclear division (figs. 9, 12). The existence of cytoplasmic fibers, on which walls are formed, is apparently characteristic of many other conifers but has not been noted in all cases.

Some proembryos may form walls after another division which produces 32 nuclei (fig. 15). This has also been reported in *T. baccata* by Jäger (1899)

Explanation of figures 7–26

All figures, save 20 and 21, are median longisections, and all are magnified × 205. FIG. 7. Male and female nuclei in contact at base of egg. FIG. 8. Binucleate proembryo at center of egg. FIG. 9. Walls forming in 16-nucleate proembryo. FIG. 10. 16-celled proembryo. FIG. 11. Very young embryo showing start of suspensor elongation. Note open cells above suspensors. FIG. 12. Walls forming in 16-nucleate proembryo. FIG. 13. 16-celled proembryo. FIG. 14. 32-celled proembryo. FIG. 15. Walls apparently just formed in 32-celled proembryo. FIG. 16. 16-celled proembryo. FIG. 17. Embryonic group at tip of elongating prosuspensor. FIG. 18. 32-celled proembryo with walls of open tier clearly coincident with those of prosuspensor tier. FIG. 19, 32-celled proembryo. FIGS. 20, 21. Cross-sections of prosuspensor groups in young embryos. FIGS. 22–26. Semi-diagrammatic drawings of embryos in stages of development from that of the embryonic group's first divisions to that just prior to differentiation of the stele promeristem and root generative meristem.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and Robertson (1907)]. However, the great majority of 16-nucleate proembryos were seen to be walled or in the process of so becoming (figs. 9, 10, 12, 13, 16). In *T. Wallichiana*, Sugihara (1945) found walls invariably formed after 16 nuclei were produced. When walls are formed, the sporophytic nuclei are rather evenly distributed throughout the dense mass of zygotic cytoplasm. The new cell walls are very thin, being most obvious where some shrinkage has taken place.

Not infrequently, the 16 newly-produced cells lie approximately in two tiers (fig. 12). Almost as often, when the archegonium is narrower, the proembryonic cells are distributed in several superposed tiers of irregular number and arrangement (figs. 9, 13). In this manner there is produced an irregularly arranged group of cells in the egg base, surmounted by a layer of cells which are separated from one another by cell plates but exposed on their upper side to the general cytoplasm of the archegonium. At wall formation the cytoplasm in each cell is still essentially as dense as was the general zygotic cytoplasm prior to cell formation. However, with further development, the cytoplasm of the proembryonic cells becomes less dense and less deeply-staining.

In the 16-celled proembryo, there are generally 9–13 cells in the uppermost, open layer and 3–7 cells in the lower, completely walled group. The proembryo may be completely formed at this stage, but more often, a further division occurs to produce about 32 cells. As noted above, this fifth division may occur in the free nuclear proembryo. The division is not always executed by every cell. Although mitotic figures were not seen, the products of the division indicate its occurrence in a manner characteristic of many taxodes and cupressads. Apparently the uppermost, open tier of cells divides transversely to produce a tier of open cells above, and an equal group of closed cells below which develop into a suspensor. (This development is described by Sugihara (1945) and may be inferred from figures 57 and 65 of Jäger (1899).) At the same time or just before suspensor elongation, the cells of the lowermost group also divide in various planes to double their number.

The mature proembryo thus formed consists of 6–14 deeply-staining embryonic cells at the lower end of the archegonium (the chalazal end), surmounted by an upper group of 9–13 more or less elongated suspensor cells (prosuspensor: Buchholz 1929). Above the suspensor group is often found a tier of 9–13 cells open to the archegonial cytoplasm above (figs. 11, 14, 18). Some embryos were found with 6 suspensor cells (fig. 21), and others had as many as 17 or 18 (fig. 20); but those with 9–13 suspensors constituted about 80 per cent of the total observed. This number represents a significant departure from the figures given for the number of suspensor cells in the embryo of *Taxus baccata:* 5–6 (Mirbel & Spach 1843); 4–6 (Schacht 1850, Hofmeister 1862); 6 at most (Strasburger 1872); usually 6, occasionally 8 or 10 (Jäger 1899).

A few proembryos were seen to lack an open tier of cells at maturity. In others, there were present in this "relict" (rosette?) tier occasional closed cells (fig. 19) and even free nuclei. In those proembryos which appear to lack the rosette tier, there may have been an earlier disintegration of the open cells than usual. On the other hand, these proembryos may possibly have been organized in the 32-nucleate condition. It is interesting to note that one 16-celled proembryo was found oriented perpendicular to the normal direction, so that the open tier faced the side rather than the micropylar end of the prothallus.

Commonly the mature proembryo occupies the lower half of the archegonium. Toward the neck, several free nuclei may be found in the general archegonial cytoplasm. These nuclei, the supernumerary nuclei from the pollen tube, eventually disintegrate. In addition to the nuclei, the upper half of the archegonium includes some cytoplasmic remnants. As in the unfertilized eggs (Sterling 1948), this upper region of the archegonium is filled by the growth of the surrounding cells of the prothallium after the embryo elongates. These continually enlarging cells at the micropylar end of the megagametophyte also grow up over the archegonia and into the tissues of the upper part of the nucellus, giving the prothallus a broad, flattened, dome-like apex.

The Early Embryo. Shortly after the organization of the mature proembryo, the suspensors begin to elongate. Although a slight amount of elongation already occurs in these cells during the proembryonic stage, the subsequent elongation is quite marked. The proembryo stage is terminated by the thrusting of the embryonic cells downward into the gametophyte tissue through the base of the archegonium (fig. 11). It may be noted that one embryo was found elongating horizontally, toward the side of the prothallus.

As in many other conifers, the future path of the embryo in the prothallus is prepared by longitudinal divisions which produce a central tract of small, densely-staining cells below the embryo. Following this development, there is a dissolution of the cells in this tissue slightly ahead of the advancing embryo. Meanwhile, the prothallus enlarges greatly at its chalazal end. The cells in this lower region divide repeatedly, becoming smaller and more numerous. The gametophyte thus becomes spherical and then prolate. A coaxial development (fig. 5) at the basal end soon brings about a pear-shaped form, which persists to seed-ripening.

During initial suspensor enlargement, the densely cytoplasmic embryonic cells at the tip of the suspensor group remain quiescent while being carried into the endosperm (figs. 17, 27). The first divisions in the embryonic group occur shortly afterward. Although the cells at the surface divide mostly by periclines and anticlines, the cells adjacent to the suspensor

divide principally by walls perpendicular to the long axis of the suspensor (figs. 23, 25). The products of these latter cells eventually elongate in succession as they are formed (figs. 6, 24–26, 35). These may elongate while the prosuspensor cells are still relatively short (figs. 29, 31, 32) or only after pronounced elongation of the latter (figs. 30, 34).

Rarely, however, do the secondarily produced suspensor cells attain the length of the prosuspensors. Although most of the prosuspensors elongate in unison and present a tiered configuration, the secondary suspensors are formed in irregular order and elongate autonomously, being produced independently by individual embryonic cells next to the prosuspensors. While elongating, the prosuspensors enlarge continually at their forward ends and experience a pronounced increase in diameter. The nucleus and most of the cytoplasm of a prosuspensor cell is to be found at its growing forward end.

Embryonic Cleavage or "Budding." As the prosuspensor develops, one or commonly more of its cells may not keep pace with the others and may separate from the main mass. Although these cells can elongate further, they no longer contribute to the main thrusting action of the group. When such a group of prosuspensor cells separate, they usually bear a few embryonic cells attached to their forward ends (figs. 29, 30, 32, 34, 36, 37). Ultimately, these embryonic cells form a meristematic group resembling that of the original embryo. Thus occurs a cleavage or splitting, resulting in the usual production of from two to four embryos, each consisting of embryonic cells borne on several prosuspensor cells.

Although cleavage (budding: Thomson 1945) of the embryo system is neither as regular nor as precise as that of pine, it occurs in a significant percentage of embryos. Approximately 30 per cent of the embryo systems showed such a cleavage. This development has also been figured in *Taxus baccata* by Mirbel and Spach (1843) and mentioned by Hofmeister (1862) and Strasburger (1872). It is interesting to note that wherever cleavage did occur, it involved the separation of prosuspensor cells. In no instance

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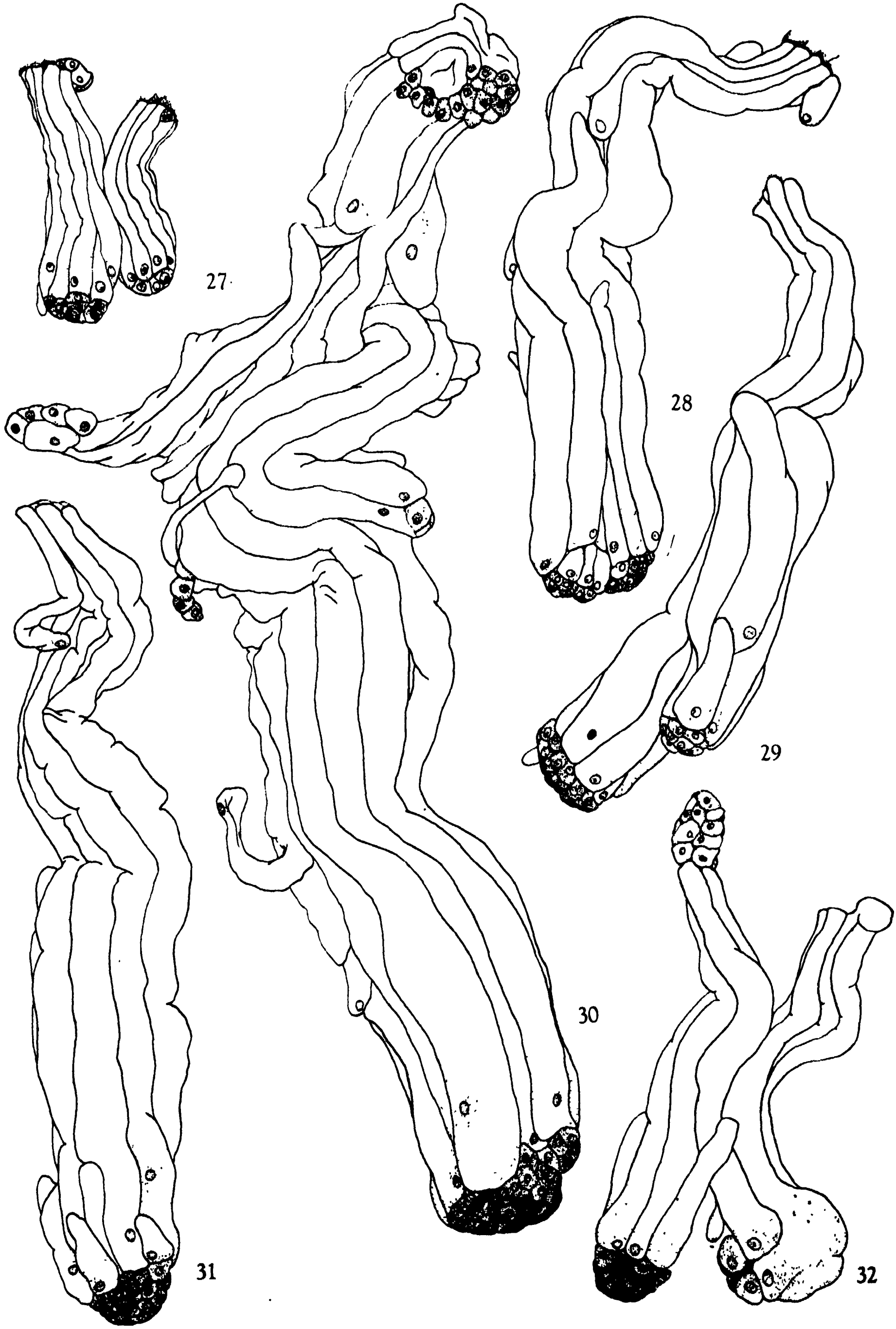
Explanation of figures 27–32

All figures × 72. FIG. 27. Two young embryos wih some cellular development in the rosette region. The embryonic group at the growing end shows little activity. FIG. 28. Embryo showing different rates of elongation in isolated prosuspensor cells. Note start of cleavage in embryonic group. FIG. 29. Stage in embryo development just subsequent to that in figure 28, with cleavage of the prosuspensors and the embryonic group. FIG. 30. Extremely varied development of different regions of embryo. Particularly shown are cleavage "embryos," rosette cells persisting, with probably some multiplication, and indications of cleavage in main embryonic group. FIG. 31. Embryo without rosette cells or cleavage. FIG. 32. Embryo with some suspensors separated at right, with attached embryonic cells organizing a new meristem. (Separation of upper ends of suspensors artificially produced.) Configuration of rosette group seems to indicate its formation within the archegonium.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was there a separation of groups of secondary suspensors at the end of a coherent prosuspensor. The splitting appears to be quite irregular, producing daughter embryos with varying numbers of prosuspensor and attached embryonic cells—hence giving rise to embryos of different vigor.

The cause of the sporadic and irregular cleavage could not readily be ascertained. The relationship of the rounding off of groups of embryonic cells to subsequent suspensor separation is unknown. That the correlation between the two developments is not always maintained is shown in embryos with a coherent embryonic group extending over suspensors which varied markedly in length. In these cases, the suspensors seem to be held together by the bond of the embryonic cells. Embryos are often seen in which it appears that a separation in the embryonic group presages the later suspensor cleavage (figs. 28, 30).

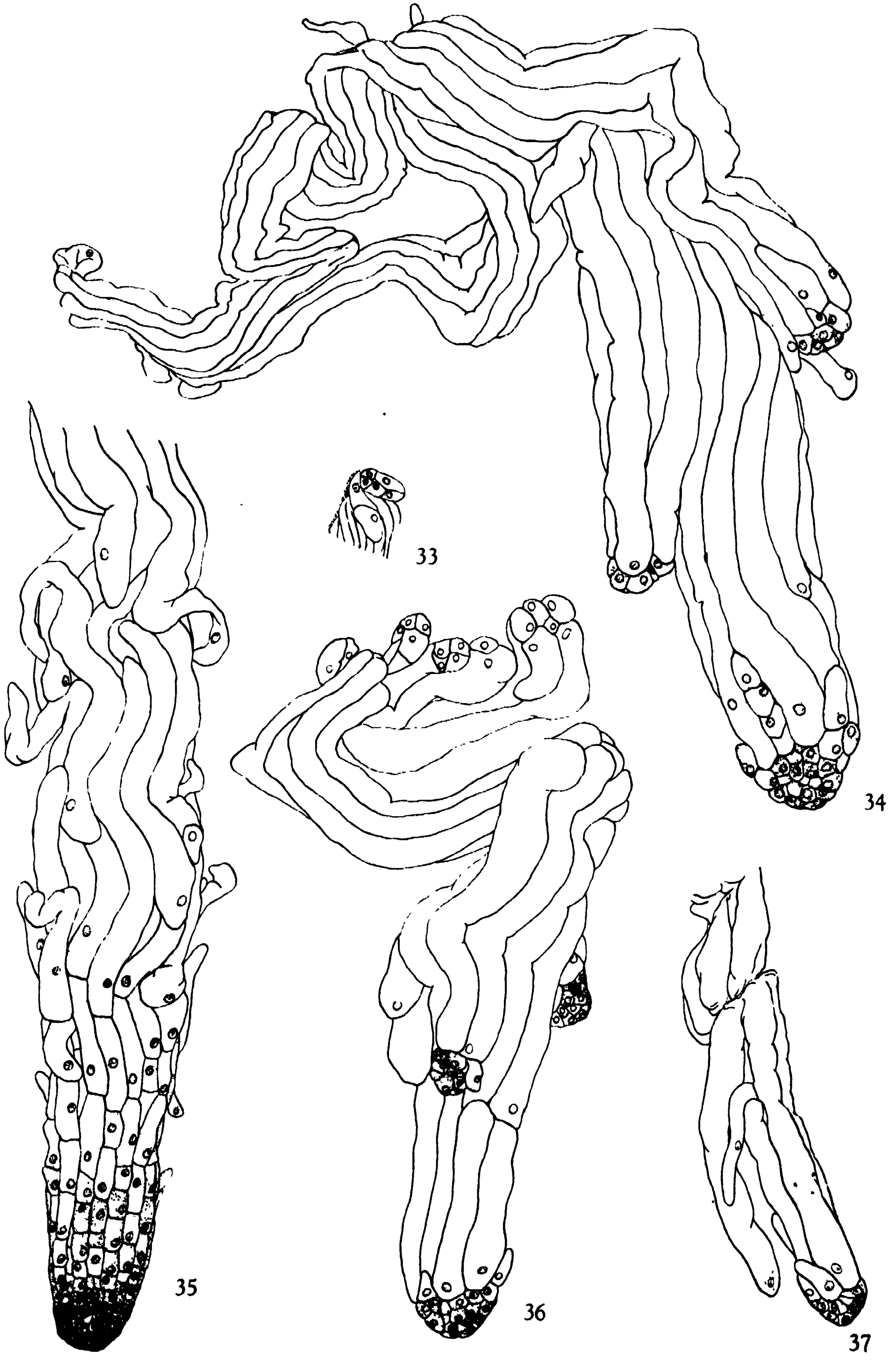
As was pointed out by Jäger (1899), isolated suspensor cells are likewise very numerous in embryo ontogeny. Occasionally an isolated cell may become meristematic at its forward end (toward the advancing embryo) and proliferate to produce a group of cells, which may or may not assume the parabolic shape of a typical embryo (figs. 4, 30, 36). Few were seen with the internal seriate cellular masses described by Jäger (1899). (In this paper, the formation of a few cells in the tip of a single suspensor cell is not considered as constituting a separate embryonic group.)

The ability of the suspensors to become meristematic is not restricted to those which have separated from their sister cells. Often a prosuspensor cell, while still part of the suspensor ensemble, will lag behind and begin to form a meristematic group at its tip. The secondary suspensors, which do not attain the length of the prosuspensors, have not been observed to form meristematic tissue.

Development of the "Rosette" Cells. In his discussion of *Cephalotaxus*, Buchholz (1925) describes the development of the rosette cells as representing the cleavage phenomenon. The similarly placed tier of open cells in *Taxus* has a variable history. One of the first developments attendant on suspensor elongation in the yew is the disintegration of most of the open cells (and free nuclei) in the tier above. Hence these can rarely be found when the proembryo stage is past. Those cells of the supra-suspensor tier which are fully organized persist much longer than their incomplete

Explanation of figures 33–37

All figures × 72. FIG. 33. Proliferation of some cells in the rosette position. FIG. 34. Embryo system with three terminal embryonic groups originating from cleavage in one embryo from single zygote. FIG. 35. Embryo at stage somewhat prior to formation of root generative meristem. FIG. 36. Embryo system showing cleavage and proliferation of cells in rosette region of embryo. Possibly some prosuspensor cleavage and proliferation is also involved here. FIG. 37. Young embryo split from larger embryo system. Note small suspensor branch cut off by formation of a cell wall.



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neighbors. Not infrequently these cells undergo a limited amount of meristematic activity and proliferate (figs. 27, 30, 32, 33, 36). However, this development does not appear to give rise to so-called "rosette embryos" but merely results in an augmentation of the small group of cells in the rosette region. It is possible that some of these proliferative cells are members of the prosuspensor which have not elongated, but the occurrence of organized rosette cells in the proembryo should not be overlooked (see also Jäger 1899 and Sugihara 1945).

The proliferation shown in figure 32 has the general configuration of an archegonium and may have been formed in the archegonium about the time of suspensor elongation. (The separation shown in the upper part of the prosuspensor in this figure was produced in manipulation.) In figure 36, the suspensor-like cells in the rosette region are probably separated, proliferating prosuspensors, but some of the groups here may be derived from cells of the rosette tier. Thus, although rosette development is sporadic and no common scheme of development may be found, it is apparent that proliferation in the rosette region may be considered a definite part of embryogeny in *Taxus*.

Formation of the Massive Embryo Primordium. Since the suspensor system elongates more rapidly than does the corrosion cavity ahead of the embryo, the former soon begins to coil back on itself, forming from four to eight or more turns. As the embryo reaches about half way down the growing prothallus, the embryonic cells divide more rapidly to form a hemispherical cap of cells at the forward end of the secondary suspensors. The more forward of the cells in the embryonic group continue meristematic; those in the rear soon elongate, forming suspensor segments. While growth at the apex occurs by divisions in all directions, enlarging the embryo primordium, those toward the suspensor divide principally by transverse divisions with the typical activity of a rib meristem (figs. 22, 35).

No definite apical cell has been found at any stage in embryonic growth although an indication of one was seen in a single embryo. Each embryonic cell appears to be active in producing groups of daughter cells. Early development at the free apex is attendant on the irregular activity of a densely-staining group of equivalent initials, which divide anticlinally and periclinally. As the free apex enlarges, oblique divisons may occur also in the subsurface cells. With continuing enlargement, anticlinal divisions begin to predominate on the forward flanks of the apex, but periclines are still frequent at the very summit. From an examination of figures 22, 24, and 26, it can be seen that growth in the older primordium involves the activity of a very small apical group, much like the apical initial-mother cell zone of the conifer shoot apex, from which the other cells of the shoot

are produced by divisions parallel to the base of this zone. However, the initial group in the *Taxus* embryo does not seem to be lightly-staining or large-celled nor to possess the other histological features of this group in the conifer shoot apex.

Soon afterward, differentiation of the "stele promeristem" takes place in the relatively undifferentiated meristematic embryo apex. This occurs by specifically oriented cell divisions just subsequent to the stage shown in figure 22. This further development will be considered in the late embryogeny of *T. cuspidata*.

Discussion. It is apparent that the proembryo of *Taxus* enjoys a general organization common to that in most of the Taxodiaceae, Cupressaceae, and even Podocarpaceae, if the unique and delayed cytokinesis of the embryonic cells in the last family is overlooked. [Cf. *Cunninghamia* (Miyake 1910; Sugihara 1941), *Taxodium* (Coker 1903; Kaeiser 1940), *Sequoiadendron* (Looby & Doyle 1937), *Podocarpus* (Coker 1902; Stiles 1912; Sinnott 1913; Tahara 1941; Looby & Doyle 1944), *Saxegothaea* (Doyle & Looby 1939), *Juniperus* (Nichols 1910), *Biota* (Cook 1939), and *Libocedrus* (Lawson 1907) among others.] The principal difference between *Taxus* and the first two families lies in the number of nuclei present at wall formation, which is at least 16 in the yew and generally eight in the taxodes and cupressads. Nichols (1910) has found the occasional production of 16 nuclei before wall formation in *Juniperus*.

Apart from the number of cells involved, the organization of a lower group of embryonic cells, a tier of prosuspensor cells, and a tier of open cells is basic to *Taxus* and most genera of these three families, and the manner of their origin is also similar. The proembryo exhibits a distinct difference from the more precisely organized ones of *Sequoia* and the callitroids. Save for its greater number of cells and the presence of a cap, the proembryo of *Cephalotaxus* is somewhat similar. It is not too difficult to derive the more specialized proembryo of *Torreya* from this apparently basic organization. The fact that this type of proembryo is common to so many families might be advanced as a support for its possible primitiveness in the Coniferae.

The type of development exhibited in the usual early embryogeny of *Taxus cuspidata* appears to vary between that of *Taxus baccata* (as described by Jäger 1899) and that of *Torreya nucifera* (Buchholz 1940). Although many embryos are like those shown by Jäger (1899), with isolated suspensor cells, a significant percentage exhibit a type of development close to that of *Torreya nucifera,* as figured by Buchholz (1940), and somewhat like that of *Cryptomeria* (see Lawson 1904b). The type of cleavage is unlike that in the *Torreya* of Tahara (1940) because the prosuspensor cells, rather than the groups of secondary suspensors alone, are sepa-

rated. Whether this type of cleavage is classified as advanced or primitive depends on the phylogenetic status assigned to cleavage polyembryony. If, as has been indicated by recent investigators, cleavage is considered a derived condition, the precision and extent of the process would appear to be a more recent acquisition. Consequently, the type of cleavage in the Torreyas would be more advanced than that in *Taxus*. Such higher status of *Torreya* would accord with the evaluation of Buchholz (1940), based on other morphological factors.

The variable development of the open cells above the prosuspensor is similar to their behavior in the embryos of *Sciadopitys* (Buchholz 1931), *Sequoiadendron* (Looby & Doyle 1937; Buchholz 1939), *Podocarpus* (Buchholz 1936, 1941), *Saxegothaea* (Doyle & Looby 1939), and perhaps in *Torreya* (cf. Tahara 1940 and Buchholz 1940) and *Austrotaxus* (cf. Saxton 1934 and Buchholz 1940). It should be recalled that Jäger (1899) occasionally found cells in the rosette position in the proembryo of *Taxus baccata*. In *Taxus Wallichiana*, Sugihara (1945) reported the usual formation of completely walled rosette cells, with the occasional production of open cells. However, the fact that proliferation may take place in these cells is no indication that they are actually embryonic (see Thomson 1945). Except for a possible development shown in fig. 36, none of the rosette proliferations were definitely seen to form embryos differentiated into suspensors and embryonic cells, nor did the groups ever develop the structure of typical embryo apices.

The data on early embryogeny in *Taxus* may help to establish its position within the Taxaceae. It is clear that much of the embryology of *Austrotaxus* (Saxton 1934) places it in a lower rank of the family: the possible presence of a ventral canal nucleus, the possession of a well-defined layer of jacket cells, and the formation of several vegetative nuclei in the pollen tube. To these might be added the unique presence of a nucellar vascular system (Sahni 1920). (The large number of neck cells in the archegonium is a moot consideration.) On the other hand, on the basis of various factors already enumerated by Buchholz (1940), the highest ranking of the three genera is *Torreya*. It is of interest to note that in general, from *Austrotaxus* to *Taxus* to *Torreya*, there is an increase in the incidence, as well as precision, of cleavage in early embryogeny.

Comparing the proembryos of *Taxus cuspidata* and *T. baccata*, it is to be seen that the former has a much larger number of cells, approximately twice that in the European yew. Possibly the proembryo of the latter may be fully organized at the 16-celled stage (with exceptions as noted above). On the other hand, the more common situation in the Japanese yew is a 32-celled proembryo, with occasional 16-celled proembryos formed. This difference may be reflected in the number of prosuspensor cells organized

in each: about 6 in *T. baccata,* as contrasted with almost double that number as an average in *T. cuspidata.* Data are still too limited for any attempt to correlate the considerable frequency of cleavage in the Japanese yew with its large number of proembryonic cells. It should be noted that Sugihara (1945) describes an increase in the number of prosuspensor cells after their organization as a result of a longitudinal division in the cells of the original prosuspensor tier. Such a development is comparatively rare for conifers.

The absence of an apical cell in the embryogeny of *T. cuspidata* conflicts with the observations of Strasburger (1872), Jäger (1899), and Kapfer (1935) on *T. baccata.* However, the fact of its presence or absence is of relatively little significance in phylogeny, as has been well shown by R. B. Thomson (1945). Strasburger arrived at the same conclusion in 1879: "Nun zeigt auch das Beispiel von *Pinus Strobus,* wie wenig die Scheitelzelle an Coniferenkeimen zu deren phylogenetischer Gruppirung verwendet werden kann."

SUMMARY

After the sexual nuclei meet in the center of the egg, they usually sink to the base where they may form a resting nucleus. Free nuclear divisions follow to produce an irregularly arranged group of at least 16, and occasionally 32, nuclei before wall formation occurs. The walls are formed on cytoplasmic fibers between the nuclei, producing a variable number of enclosed cells in the base of the archegonium, surmounted by a layer of cells which are walled off from each other but exposed above to the general egg cytoplasm. Another division follows to produce about 32 cells, consisting most commonly of 9–13 open cells (rosette), 9–13 suspensor cells (prosuspensor), and 6–14 embryonic cells at the base.

After suspensor elongation, varying numbers of prosuspensor cells may separate from one another, with or without embryonic cells attached to their tips. More often, the embryo develops without such cleavage. Separated groups of cells produce embryonic assemblages of varying sizes and vigor; separated single prosuspensor cells may experience a certain amount of proliferation. In the rosette region, the open cells generally disintegrate, but some which are completely walled may undergo a limited series of divisions. Also in this region, non-elongating suspensor cells can proliferate actively.

The embryo primordium gradually becomes massive by periclinal and anticlinal divisions at the free apex, while rib-meristem activity behind the apex contributes to its mass as well as to that of the suspensor.

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Literature Cited

Allen, G. S. 1946. Embryogeny and development of the apical meristems of *Pseudotsuga*. I. Fertilization and early embryogeny. Am. Jour. Bot. **33**: 666–677.

Buchholz, J. T. 1918. Suspensor and early embryo of *Pinus*. Bot. Gaz. **66**: 185–228.

————. 1920. Polyembryony among Abietineae. Bot. Gaz. **69**: 153–167.

————. 1925. The embryogeny of *Cephalotaxus Fortunei*. Bull. Torrey Club **52**: 311–323.

————. 1929. The embryogeny of the conifers. Proc. Int. Congr. Plant Sci. (1926) **1**: 359–392.

————. 1931. The suspensor of *Sciadopitys*. Bot. Gaz. **92**: 243–262.

————. 1936. Embryogeny of species of *Podocarpus* of the subgenus *Stachycarpus*. Bot. Gaz. **98**: 135–146.

————. 1938. The dissection, staining and mounting of the embryos of conifers. Stain Tech. **13**: 53–64.

————. 1939. The morphology and embryogeny of *Sequoia gigantea*. Am. Jour. Bot. **26**: 93–101.

————. 1940. The embryogeny of *Torreya*, with a note on *Austrotaxus*. Bull. Torrey Club **67**: 731–754.

————. 1941. Embryogeny of the Podocarpaceae. Bot. Gaz. **103**: 1–37.

Chamberlain, C. J. 1910. Fertilization and embryogeny in *Dioon edule*. Bot. Gaz. **50**: 415–429.

Coker, W. C. 1902. Notes on the gametophytes and embryo of *Podocarpus*. Bot. Gaz. **33**: 89–107.

————. 1903. On the gametophytes and embryo of *Taxodium*. Bot. Gaz. **36**: 1–27, 114–140.

Cook, P. L. 1939. A morphological comparison of two species of *Thuja*. Ph.D. Thesis. Univ. of Illinois.

Doyle, J. & Looby, W. J. 1939 Embryogeny in *Saxegothaea* and its relation to other podocarps. Sci. Proc. Roy. Dublin Soc. **22**: 127–147.

Goebel, K. 1933. Organographie der Pflanzen. 3te Aufl. 3ter Teil: Samenpflanzen. G. Fischer. Jena.

Hofmeister, W. 1862. On the germination, development, and fructification of the higher cryptogamia and on the fructification of the coniferae. Transl. by F. Currey. Ray Soc. London.

Jäger, L. 1899. Beiträge zur Kenntniss der Endospermbildung und zur Embryologie von *Taxus baccata* L. Flora **86**: 241–288.

Kaeiser, M. 1940. Morphology and embryogeny of the bald cypress, *Taxodium distichum* (L.) Rich. Ph.D. Thesis. Univ. of Illinois.

Kapfer, E. 1935. Zur Kenntnis der Embryobildung bei den Coniferen. Inaug.-Dissert. II. Sekt. Ludwig-Maximilians-Univ. München.

Lawson, A. A. 1904a. The gametophytes, archegonia, fertilization and embryo of *Sequoia sempervirens*. Ann. Bot. **18**: 1–28.

————. 1904b. The gametophytes, fertilization and embryo of *Cryptomeria Japonica*. Ann. Bot. **18**: 417–444.

————. 1907. The gametophytes and embryo of the Cupressineae with special reference to *Libocedrus decurrens*. Ann. Bot. **21**: 281–301.

Looby, W. J. & Doyle, J. 1937. Fertilization and proembryo formation in *Sequoia*. Sci. Proc. Roy. Dublin Soc. **21**: 457–476.

———— & ————. 1939. The ovule, gametophytes, and proembryo in *Saxegothaea*. Sci. Proc. Roy. Dublin Soc. **22**: 95–117.

——— & ———. 1944. Fertilization and early embryogeny in *Podocarpus andinus*. Sci. Proc. Roy. Dublin Soc. **23**: 257–270.

Mirbel, C. F. B. de & Spach, E. 1843. Notes sur l'embryogenie des *Pinus Laricio* et *sylvestris*, des *Thuya orientalis* et *occidentalis*, et du *Taxus baccata*. Ann. Sci. Nat. Bot. II. **20**: 257–268.

Miyake, K. 1910. The development of the gametophytes and embryogeny in *Cunninghamia sinensis*. Beih. Bot. Centr. **27**: 1–25.

Nichols, G. E. 1910. A morphological study of *Juniperus communis* var. *depressa*. Beih. Bot. Centr. **25**: 201–241.

Robertson, A. 1907. The Taxoideae; a phylogenetic study. New Phytol. **6**: 92–102.

Sahni, B. 1920. On certain archaic features in the seed of *Taxus baccata*, with remarks on the antiquity of the Taxineae. Ann. Bot. **34**: 117–133.

Saxton, W. T. 1913. Contributions to the life-history of *Tetraclinis articulata*, Masters, with some notes on the phylogeny of the Cupressoïdeae and Callitroïdeae. Ann. Bot. **27**: 577–605.

———. 1934. Notes on conifers. VIII. The morphology of *Austrotaxus spicata* Compton. Ann. Bot. **48**: 411–427.

Schacht, H. 1850. Entwickelungs-Geschichte des Pflanzen-Embryon. J. C. A. Sulpke. Amsterdam.

Sinnott, E. W. 1913. The morphology of the reproductive structures in the Podocarpineae. Ann. Bot. **27**: 39–82.

Sterling, C. 1948. Gametophyte development in *Taxus cuspidata*. Bull. Torrey Club **75**: 147–165.

Stiles, W. 1912. The Podocarpeae. Ann. Bot. **26**: 443–514.

Strasburger, E. 1872. Die Coniferen und die Gnetaceen. H. Dabis. Jena.

———. 1879. Die Angiospermen und die Gymnospermen. G. Fischer. Jena.

Sugihara, Y. 1941. The embryogeny of *Cunninghamia lanceolata* Hooker. Sci. Rep. Tôhoku Imp. Univ. IV. Biol. **16**: 187–192.

———. 1945. The proembryogeny of *Taxus Wallichiana* Zuccarini. Bot. Mag. Tokyo **59**: 96–98.

Tahara, M. 1940. Embryogeny of *Torreya nucifera* S. et Z. Sci. Rep. Tôhoku Imp. Univ. IV. Biol. **15**: 419–426.

———. 1941. Embryogeny of *Podocarpus macrophyllus* and *Podocarpus Nagi*. Sci. Rep. Tôhoku Imp. Univ. IV. Biol. **16**: 91–98.

Thomson, R. B. 1945. "Polyembryony": sexual and asexual embryo initiation and food supply. Proc. Trans. Roy. Soc. Canada III. **39** (Sect. V): 143–169.

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EXPERIMENTS UPON THE REGENERATION OF CERTAIN SPECIES OF PELTIGERA; AND THEIR RELATIONSHIP TO THE TAXONOMY OF THIS GENUS

JOHN W. THOMSON, JR.

During the course of studies on the lichen genus *Peltigera* in preparation of a paper on the North American species of this group it became apparent that there was a curious sequence of species which paralleled another group of species in all characters save one, the possession of isidia. Thus *P. praetextata* has isidia but *P. canina,* its counterpart, does not; *P. zopfii* has isidia but *P. horizontalis* does not; *P. microphylla* has isidia but *P. polydactyla* does not. In most groups of lichens, the presence of isidia is in the present day concepts regarded as sufficient to delimit species. For example, monographs of *Parmelia* by Tavares, of *Alectoria* by Du Rietz, of *Usnea* by Motyka and papers by many other lichenologists accept the presence or absence of isidia as good characters for the separation of lichen species. In the genus *Peltigera* this concept has been carried out to its fullest extent in the many and scattered writings of V. Gyelnik (6–12).

Examination of the many specimens necessary for the preparation of a paper on the North American species led to the following observations: (1) *P. evansiana* Gyel. has cylindrical isidia which are not particularly associated with cracks or holes in the thallus or with the thallus margins and are scattered over the upper surface. (2) Specimens of other species, those in the second column of table 1, have isidia of quite different character. They are flattened and, more significantly, they are grouped closely around holes, cracks and breaks in the upper surface or on the margins, only occasionally being scattered over the surface. (3) A third, peltate, type of isidium is present in *P. lepidophora.*

The isidia of some species of *Peltigera* have been quite thoroughly studied. Nilson (16) mentioned isidia along with soredia saying that their production is dependent upon the environment and that individuals bearing such structures should be termed forms rather than species. Strato (17) regarded the isidia as regeneration structures in *P. canina* as a result of his experiments with plants under bell jars. He found that light, a moist atmosphere and a substratum of earth or moist clay were necessary to produce regeneration. Linkola (13) also experimented upon the same plant, under the name *P. praetextata.* He observed plants in the open for two years and found that isidia were formed only where two years previously artificial cuts had been made. The fact that regeneration followed wounding should not be surpris-

ing but Linkola claimed that the development in this case is unique and met with only in *P. praetextata* and not in *P. canina.* Darbishire in one paper (2) expressed a doubt as to the validity of *P. praetextata* as a species, calling it a form or state of *P. rufescens*, although in a later paper (3) he called it a species. He called attention to the fact that the isidia are associated with cracks and affirmed the view that they are "largely organs of assimilation." Du Rietz (4) has given us the term *squamiformia* to describe the type of isidia in *P. lepidophora* and in *P. praetextata* as he called it. In the papers of Gyelnik are many "species" characterized by the presence of isidia. He has accepted the premise that isidia are good characters for the differentiation of species of *Peltigera* and has described, as Magnusson (15) put it ". . . eine Fülle von arten, deren Zähl wir noch nicht kennen." To find, as Magnusson points out, a single isidium on a thallus would mean that one would have to shift the classification of his specimen into the group with isidia.

The examination of herbarium specimens left me with the opinion that the isidia of the species of *Peltigera* other than *P. evansiana* and *P. lepidophora* were probably nothing but normal regeneration of the common species. In order to decide this point to my own satisfaction, experiments were set out during the summer of 1946 in the Brule River valley in Douglas County in Northern Wisconsin. Here several species of *Peltigera* were available in undisturbed natural condition. Plants of *Peltigera canina* and its var. *rufescens, P. horizontalis,* and *P. polydactyla* were observed at several stations. Some lobes were cut with a scalpel, "UW" being cut through the younger lobes. Other lobes were crushed by stepping on them to simulate the damage that might be done by deer, rabbits, squirrels, or other animals. A third set of lobes was left as controls. The location of each set of lobes was carefully noted.

One year later, during the summer of 1947, the experimental plants were reexamined. All the lobes which had been crushed in each of the three species had regenerated freely, with an abundance of the characteristic squamiform isidia. The undisturbed controls remained unchanged except for having grown larger during the year. The lobes which had been cut with the initials "UW" were not so uniform; some of them had regenerated profusely along the edge of the cuts, others not at all, even on the same thallus.

It does not seem reasonable that some parts of one thallus are an isidoid "species" and other parts a non-isidoid species. But this would be the conclusion necessary if one would follow Gyelnik's keys to *Peltigera.* One comes to the conclusion that the isidia, at least in the three species experimented upon, are regeneration phenomena worthy at most of recognition as forms if one follows the current practice, as in the *Cladoniae,* of giving such trivial variations nomenclatorial recognition. The ordinary expansion and contrac-

tion of the thallus with changes in the moisture content are often sufficient to produce the cracks and initiate the formation of the isidia. In specimens one often sees clusters of isidia around the holes produced by snails or insects feeding on these lichens. The fact that specimens of *P. canina* f. *innovans* growing on rounded boulders in woods are frequently isidoid suggests a link with the feeding habits of squirrels and chipmunks. In clambering to the tops

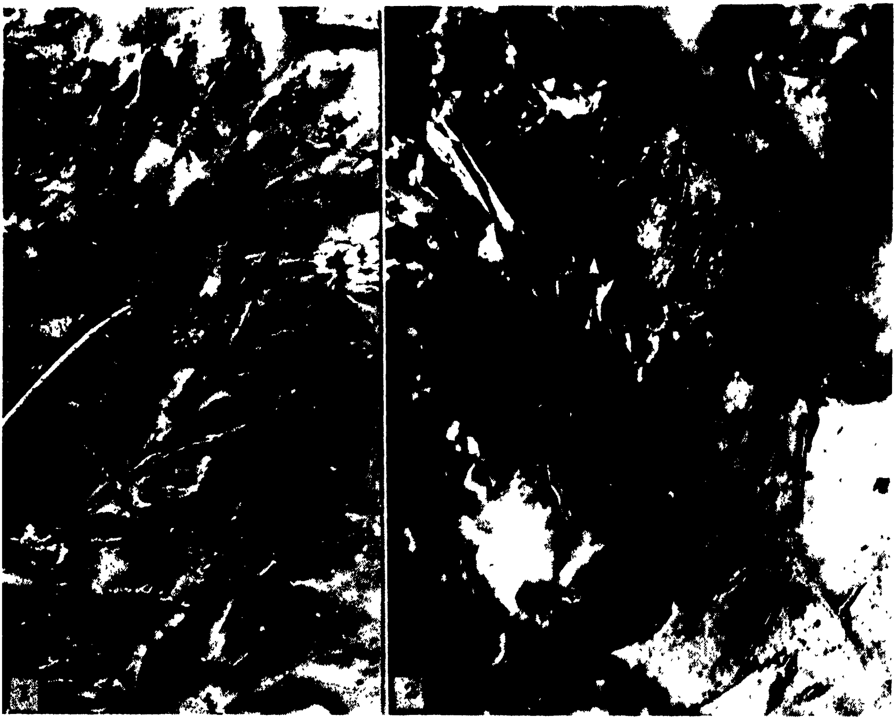

FIG. 1. *Peltigera canina* showing the abundant formation of regeneration squamules or "isidia" one year after the gross wounding of crushing. × 3. FIG. 2. *Peltigera polydactyla*. Two lobes on the same piece of thallus cut by a scalpel in the initials "UW"; regeneration squamules formed along the cuts on the upper lobe and little regeneration on the lower lobe. × 3.

of the boulders the animals are likely to cause damage to the thallus, with consequent regeneration.

The cleanness of the cut and the resultant amount of wounding may explain the inconsistency of regeneration following cutting with a scalpel. Both Linkola and I found that regeneration did not always follow such wounding. He interpreted his results as showing one species which regenerated and another which did not. My results, in which some lobes regenerated and others on the same thallus did not, would refute this idea, particularly

when the gross wounding or crushing was always followed by the formation of the regeneration lobes or isidia.

The isidia of *P. lepidophora* were thought by Bitter (1) to be cephalodia, the algae being derived from outside the thallus although also being of the same type as that of the thallus, i.e. Myxophyceae. Linkola (14), studying sections of the thallus, showed that contrary to Bitter's studies they are not cephalodia but that the algae come from the thallus. An excellent plate in Linkola's paper is very convincing for his view. Darbishire (2) and Goebel (5) reexamining the same species also supported Linkola's view. Strato (17) and Darbishire (3) have given descriptions of the formation of the isidia in *P. praetextata* (as they called it) and both showed that the algae came from the thallus; both also leaned to the opinion that moist conditions are most favorable for the growth of isidia. Darbishire gives a very good statement of the origin. A mass of hyphae just below or just within the algal layer be-

TABLE 1. *Regeneration Forms of North American Peltigeras*

Parent species	Isidoid "species"	Correct form name
P. canina (L.) Willd. including var. *rufescens* (Weis.) Mudd.	*P. praetextata* (Flk.) Vainio *P. subcanina* Gyel.	f. *innovans* (Körb.) Thoms.
P. horizontalis (Huds.) Baumg.	*P. zopfii* Gyel.	f. *zopfii* (Gyel) Thoms.
P. polydactyla (Neck.) Hoffm.	*P. microphylla* Gyel.	f. *microphylla* Anders
P. polydactyla or *P. horizontalis* but sterile and cannot be placed	*P. elisabethae* Gyel.	

comes meristematic and forms small knobs which contain a few algae. At first the knobs are continuous with the algal layer but ultimately these form the flat leaf-like or squamiform isidia which are more or less horizontal and oriented dorsiventrally. The cortex is continuous over both surfaces but Darbishire found the upper to be thicker, with a depth of two to three cells, whereas the lower is only one cell in thickness. Tobler (18) as well as Strato considered the algae to be the initiators of the formation of isidia; Darbishire regarded the fungal activity as the primary cause. Darbishire regarded the isidia as a device which increased the photosynthetic area and only accidentally functioned as organs of reproduction. To my mind they are, in most species, merely a response to injury and are not a normal development adapted primarily either for assimilation or reproduction although they may serve these functions.

It would thus appear that in *Peltigera* there are different types of "isidia" which may or may not be used as the basis of classification of species. In *P. evansiana* there are cylindrical true isidia which are not

associated with wounding and occur scattered over the thallus. The presence of these isidia, as in *Parmelia, Usnea, Leptogium* and *Alectoria,* is a good specific character. Likewise the peltate isidia of *P. lepidophora* may be considered as satisfactory for the delimitation of this species. In addition, neither of these two species of *Peltigera* has an analogous species which lacks isidia. However, the "species" listed in the second column of table 1 have isidia of quite a different character. As Du Rietz has pointed out, they are squamiform and oriented dorsiventrally. Furthermore, they arise as a result of wounding and the "species" bearing them are paralleled by a sequence of species which lack isidia but are otherwise similar. The isidia of these species are not true isidia but false isidia, arising as regeneration structures, and their presence or absence is not a good specific character.

The result of these experiments is summarized in table 1 in which the regeneration form is listed under the correct name as well as the incorrect "species" name, and the corresponding parent species is noted. For the extensive synonymy of these forms the writer's papers (19, 20) should be consulted.

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Literature Cited

1. **Bitter, G.** 1904. Peltigerastudien II. Das verhalten der oberseitigen Thallusschuppen d. *Peltigera lepidophora* (Nyl.). Ber. Deuts. Bot. Ges. **22:** 251–254.
2. **Darbishire, O. V.** 1924. Presidential Address. Some Aspects of Lichenology. Trans. Brit. Mycol. Soc. **10:** 10–28.
3. ————. 1926. The structure of *Peltigera* with especial reference to *P. praetextata.* Ann. Bot. **40:** 727–758. *pl. 28–31.*
4. **Du Rietz, G. E.** 1924. Die soredien und isidien der Flechten. Sv. Bot. Tidsk. **18:** 371–396.
5. **Goebel, K.** 1926. Morphologische und biologische Studien VII. Ein Beitrag zur Biologie der Flechten. Ann. Jard. Bot. Buitenzorg **36:** 1–83.
6. **Gyelnik, V.** 1932. Additamenta ad cognitionem lichenum extra-europaeorum. Ann. Crypt. Exot. **4:** 166–174.
7. ————. 1932. Clavis et enumeratio specierum generis *Peltigerae.* Rev. Bryol. Lichenol. **5:** 59–73.
8. ————. 1938. Fragmenta Lichenologica I. Lilloa **3:** 49–80.
9. ————. 1929. Lichenologiai Kozlemenyek 4–7. Magy. Bot. Lapok **27:** 91–93.
10. ————. 1929. Lichenologiai Kozlemenyek 8–19 (Nos. 8–10, 14–16). Magy. Bot. Lapok. **28:** 57–61.

11. ———. 1927. Nehany *Peltigarum*-adat Japanbol. Magy. Bot. Lapok **25**: 252–256. (1926.)

12. ———. 1927. *Peltigera* tanulmanyek. Bot. Közlemenyek **24**: 122–140.

13. **Linkola, K.** 1922. Ueber die Isidienbildung der *Peltigera praetextata* (Flk.) Zopf. Ann. Soc. Zool. Bot. Fenn. Vanamo **1**: 65.

14. ———. 1913. Ueber die Thallusschuppen bei *Peltigera lepidophora* (Nyl.). Ber. Deuts. Bot. Ges. **31**: 52–54.

15. **Magnusson, A. H.** 1933. Gedanken über Flechtensystematik und ihre Methoden. Medd. Göteborg. Bot. Träd. **8**: 49–76.

16. **Nilson, Birger.** 1903. Zur Entwickelungsgeschichte, Morphologie und Systematik der Flechten. Bot. Not. **1903**: 1–33.

17. **Strato, C.** 1921. Ueber Wachstum und Regeneration des Thallus von *Peltigera canina.* Hedwigia **63**: 11–42.

18. **Tobler, F.** 1909. Biologische Flechtenstudien I. Ber. Deuts. Bot. Ges. **27**: 421.

19. **Thomson, John W., Jr.** The species of *Peltigera* of North America north of Mexico. [unpublished manuscript.]

20. **Thomson, John W., Jr.** 1947. The Wisconsin species of *Peltigera.* Trans. Wis. Acad. **38**: 249–272.

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OVERSUMMERING AND OVERWINTERING OF THE CEREAL RUST FUNGI

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The annual recurrence of cereal rusts has attracted much attention throughout the world on account of the great losses caused by them in the production of cereals. The life cycle of most of these fungi is believed to develop on two hosts: the cereal and another alternate host. In some parts of the world the alternate hosts are undoubtedly indispensable for the completion of the life cycle and are important agents of epiphytotics, but apparently in the majority of countries the alternate hosts do not play the role which has been given to them. In Australia and South Africa there are no wild species of *Berberis* to serve as alternate hosts of *Puccinia graminis,* which nevertheless occurs annually with considerable severity. When the alternate hosts of the cereal rusts do actually occur, they are often not naturally infected or, if so, very slightly and at such periods that they cannot be made responsible with absolute certainty for transmitting the infection to the cereals.

The annual infection of cereals and of the alternate hosts has been attributed to one or more of the following causes: (1) to urediniospores or aeciospores which remained viable during summer and winter; (2) to resting mycelium which survived during unfavorable periods in volunteer cereals, in wild grasses, or in dead plant materials, and from which urediniospores are produced; (3) to resting mycelium which was able to live during summer and/or winter in the alternate host and from which aeciospores are formed; (4) to teliospores that remained viable and the basidiospores produced from them, which infect the alternate hosts on which aeciospores are produced; (5) to mycoplasm, mycelium, or urediniospores that remained in or on the seed; (6) to urediniospores or aeciospores which have been transported by the wind directly or in successive steps from localities in which either of these have remained viable or their production has been continued; (7) to teliospores or basidiospores which have been transported from other districts.

Of the investigators who have worked on rusts in Greece, Politis (1929) has studied the rusts which parasitize cereals and grasses in Attica. While he ascertained that *Berberis cretica* growing on Mount Parnes is attacked by *Puccinia graminis,* he believes that the presence of this host does not have the special significance which has been attributed to it by De Bary (1865) to *B. vulgaris* in transmitting the disease to cereals. Later, the same

author in collaboration with Maire (1940) published a treatise concerning the fungi occurring in Greece, among which are many species of Uredinales. According to Stakman (1923, 1934), who visited this country during the summer of 1922, the infection of cereals by stem rust in the plains probably comes on the one hand from the bushes of *B. cretica*, growing on the mountains, which he found severely infected, and on the other, from the uredinio-phase which oversummers on the susceptible grasses on the mountains. Each year, the urediniospores are transported by the wind to the plains where they infect the cereals and the wild grasses. The holding-over of stem rust in the uredinio-phase at lower altitudes is considered by him improbable, not so much because of the severity of winters, as because of the high temperature and dryness during summers, as a result of which it is impossible for the cereals and the majority of grasses to remain green and thus make it possible for the uredinio-phase to be propagated.

At the beginning of the study of the occurrence of cereal rusts, the alternate hosts were the subject of investigation. Of the cereal rusts known to have alternate hosts, including *P. graminis, P. triticina, P. simplex, P. coronata, P. dispersa*, and *P. sorghi*, the stem rust has *Berberis cretica,* growing at altitudes of 900–1500 m., as an alternate host, and *P. dispersa,* according to Politis (1929), completes its cycle on certain species of *Anchusa.* The other alternate hosts have not till now been found to be naturally infected, or are lacking. It has been ascertained that only a few teliospores of *P. graminis tritici,* kept under natural conditions, are able to germinate in the middle of April at a temperature of 18° C, and after remaining 5 days in a hanging drop, the basidia that were produced did not develop basidiospores. From the cereal rusts only the teliospores of *P. simplex* were found to germinate rather well at the end of April after remaining in a hanging drop for 12–48 hours. Basidiospores were produced or each of the four cells of the basidium formed a long hypha. Urediniospores of *P. graminis tritici* produced at the beginning of May germinated very well. On the contrary at the beginning of July freshly produced urediniospores have about 2 per cent germination. The average temperature in July, varying from 21.2° C to 32.5° C, is conducive to abundant production of urediniospores but is not favorable for their germination. In other words the stem rust produces urediniospores most of which are never able to germinate. The small proportion that can actually germinate lose their capacity for germination in 2 or 3 days. The duration of the germinating ability of urediniospores for the other cereal rusts is even smaller. It is not only in July that the temperature is very high; the whole summer is hot and dry and lasts from May to the middle of September and sometimes is protracted to the middle of October.

All of the possible ways of oversummering and overwintering of the

cereal rusts were put to test. The transportation of spores has been followed by means of spore traps.

Finally the conclusion was reached that none of the given explanations could be taken as satisfactory for the appearance of cereal rusts in Attica. By mid-April *B. cretica* is not infected by stem rust, while this and the orange leaf rust have been found on cereals as early as April 9. The rusts seemed to remain on the spot by some means other than the hitherto proposed means of propagation. Many things were suspected as having a connection with the rusts, especially those that fortuitously occurred with the rust pustules. Certain cells were particularly suspected as being responsible for rust infections in the spring and in order to prove this (later it was ascertained that these cells had no connection with the rust fungi), rust material was kept from one season to the other for inoculation tests. These tests involved the stem rust and the orange leaf rust, as these are the most abundant here. Spores were scratched from the infected leaves and culms, the dust thus derived being a mixture of urediniospores and teliospores of both rusts, together with other fungus and host material. There was no effort made to collect spore material separately from each rust as the main problem was to find out if they could be propagated by it. Spore material was kept from one rust season to the other in the following ways: (1) in a glass container held in a glass moist chamber; (2) on pieces of pith that were placed on moist sand in a glass chamber; (3) on pieces of culms with the leaf sheaths around them which were pinned on a block of wood and kept in a glass chamber that was kept moist. All chambers were kept under natural conditions. Also, (4) a bundle of severely infected plants was kept on the ground in a shady place in the open under a couple of stones. Under each of these four conditions of storage there was a variation in the degree of moisture but all were subject to the same variations in temperature during summer and winter. Infections from spore material kept under all four conditions were positive. Uredinia of *P. graminis tritici* and *P. triticina* were produced 8–10 days after inoculation on a susceptible wheat variety "pusa," both in young and advanced stages of development. Later telia were also produced. The first positive infection was observed on June 5, 1945. In 1946 the inoculations were made earlier and so more successful results were obtained from May 20 on, owing to the more favorable climatic conditions.

Under all four conditions of storage the material was pretty well decomposed, being infected during the year by various saprophytic fungi. Of the urediniospores only the walls still remained and of the teliospores the majority were destroyed. The production of infections in the spring by such material indicates that the means by which the rusts propagated have the ability to resist and survive.

These results lead to the conclusion that the cereal rusts in Attica propagate themselves by some means—other than the usual urediniospores or teliospores—that remain in the rust pustules. In nature, perhaps after it is detached from the pustules, it remains also on the ground. It is very likely that these facts hold true for other parts of the world. Of the actual means of propagation it is difficult to say anything at this time.

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Literature Cited

1. **De Bary, A.** Neue Untersuchungen über die Uredineen, inbesondere die Entwicklung der *Puccinia graminis* und der Zusammenhang derselben mit *Aecidium berberidis*. Monatsber. Preuss. Akad. Sitzber. 12 Ja 1865.
2. **Maire, R. & Politis, J.** Fungi hellenici. Actes Inst. Bot. Univ. Athènes **1.** 1940.
3. **Politis, J.** Sur les rouilles de graminées en Attique. Proc. Acad. Athens **1929.**
4. **Stakman, E. C.** Barberry eradication prevents black rust in Western Europe. U. S. Dep. Agr. Circ. **269.** 1923.
5. ——————. Epidemiology of cereal rusts. Proc. V. Pacif. Sci. Congr. **1933.** 1934.

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THE NOMENCLATURE OF HYBRIDS

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To a large extent the wording of the Rules of Nomenclature is an inheritance from the past. Successive conferences have added provisions, modified others, but have left much of the general structure unchanged. This is notably true of the parts dealing with "hybrids"—articles which preserve many of the actual words of Alphonse de Candolle written in 1867. Considering the vast strides which genetics has made in recent years, this stability of nomenclature merits attention. Sprague wrote in 1939 that "the present rules concerning hybrids (Art. 31–34) date essentially from 1905, having undergone but little change since then."[1] This is surprising enough. But still more surprising is another article which defines the categories treated in Articles 31–34; the wording of this article, basic to an understanding of the others, *has not changed significantly since 1867.* Here is the present English version:

> Art. 14. The fertilization of one species by another may give rise to a hybrid (*hybrida*); that of a subdivision of a species by another subdivision of the same species may give rise to a half-breed (*mistus*).

It is worthy of note that the French version has undergone more verbal change in these 80 years than the English, and that the latter, quoted above, is not an exact translation of the French. In 1867 de Candolle wrote: "la fécundation d'une espèce par une autre espèce, crée un hybride (*hybridus*), ..." The French text of the present *Rules* (ed. 3) has "La fécundation d'un végétal d'une espèce par un autre, se rattachant à une autre espèce, donne naissance à un hybride (*hybrida*)." The English wording indicates a certain disregard of fundamental biology, for it could be interpreted as meaning that all members of the several species or subdivisions may be involved. While such a mass-hybridization is perhaps theoretically possible, it would certainly be a remarkable phenomenon in the vegetable kingdom. Since the rules seek to bring precision to the practice of nomenclature, it is legitimate to expect that they be precise in their phraseology. *Individuals hybridize but species do not.*

Moreover, the sort of distinction that is here implied between species and their subdivisions has no place in modern biological science: it is not only pre-Mendelian in flavor, but even has a marked pre-Darwinian odor. Whether a population is a species or a subdivision of a species rests not on some absolute criterion, but upon empiric considerations such as morphologic stability, genetic behavior, geographic range. To set up, therefore,

[1] Chron. Bot. 5: 209.

two categories, "hybrid" and "half-breed," gives us a nomenclatural system which is at variance with the facts of nature as we understand them.

Article 31 adds to the confusion by appending still another category, "asexual hybrids (graft hybrids, chimaeras, etc.)," whose relation to the other two is hard to discern. This category *seems* to be a subdivision of "hybrids," and not to be found in "half-breeds"; it appears either that graft hybrids and chimaeras (to say nothing of "etc.") either do not occur among subdivisions of one species, or that if they occur they are not to be named. It is not, indeed, clear how such a mixture as a graft hybrid or a chimaera can be included in either category, hybrid or half-breed, since both of these are defined (in Art. 10) as the result of fertilization. Or is it possible that, as they are here used, these terms still preserve some taint of ancient folk-lore? For centuries vegetable chimaeras were thought to be the result of "hybridization," and the consideration of them in the same paragraph with "graft hybrids" leads one to the conclusion that those who tacitly accepted this juxtaposition in 1930 and again in 1935 still held to the medieval concept. The cytogenetic nature of both sectorial and periclinal chimaeras has been understood for many years; and modern genetics knows of no "hybridity" due to the grafting of plants.

What is a hybrid? We do not know just what the geneticist would reply to this question; very probably several geneticists would give several answers. The word has acquired much additional significance since its use in the middle of the last century. Then it was applied mainly to the first generation of "crosses," usually sterile or nearly so. Hybrids, in this sense, were often described by systematists; they were more or less intermediate in appearance between their putative parents, and could often be recognized by their sterility. Bentham in 1858 gave rules for the recognition of such hybrids ("anomalous specimens").[2] For example, Rowlee in 1891 used Bentham's rules in concluding that the plant known as *Solidago serotina* var. *gigantea* A. Gray was actually a hybrid between *S. serotina* and *S. canadensis*, the decisive factor being the absence of fertile achenes.[3] In this sense a hybrid was an occasional individual; it did not form a population, and presented no real problem in the taxonomic picture.

This view of hybrids is held chiefly by taxonomists concerned with exploratory studies, in which their knowledge of species is limited to specimens preserved in herbaria. The usefulness of such work cannot be denied, and much exploratory taxonomy still remains to be done. But the systematist working in regions which are better known is ready to make deeper inroads into an understanding of nature. Indeed this sort of attack is well under way; the cooperation of taxonomy, genetics, and cytology is

[2] Handb. Brit. Fl. 32, 33.

[3] Bull. Torrey Club **18**: 86, 87; **19**: 312.

a fact, not a hope for the future. Although the words "*mule* of florists" did disappear from this part of the rules between 1910 and 1930, perhaps indicating some slight awareness by taxonomists of a changed outlook in genetics, the astonishing thing is that a congress meeting in 1935 could still use almost the exact phraseology of 1867 and accept the implications thereof.

Let us look at only a portion of the record. In 1899 the sterile hybrid *Primula kewensis* appeared, was subsequently obtained by controlled crossings, and later gave rise to fertile plants. By 1929 the polyploid nature of this fertile material was understood.[4] In 1917 Winge propounded his hypothesis of the origin of new races by hybridization followed by chromosome doubling;[5] this received experimental confirmation in *Nicotiana* in 1925,[6] in *Viola* in 1926,[7] and by Karpechenko's well known *Raphano-Brassica* cross in 1927.[8] By the time of the 1930 Congress, then, it was well established that new, reasonably stable, fertile races could arise out of hybrids. The origin of species by such methods was conjectured in *Fragaria* (1926),[9] *Rubus* (1927),[10] *Dahlia* (1929):[11] and between the 1930 Congress and that of 1935 the number of species that had been shown to have had (or probably had) what is fundamentally a hybrid origin was further extended. Yet we read in Article 10 that "every individual plant, interspecific hybrids and chimaeras excepted, belongs to a species . . ." Unless we suppose that something other is here meant than the result of the "fertilization of one species by another," we must deny specific status to *Iris versicolor*,[12] *Galeopsis tetrahit*,[13] *Spartina townsendii*,[14] and many others whose hybrid origin is generally accepted. Or should we further obfuscate the situation by accepting them as polyploid "species," with no regard for their bispecific ancestry?

It is immaterial at this point what definition of "hybrid" may be finally approved by geneticists and biosystematists. The fact is that species can and do arise by hybridization and that polyploid forms derived in this manner have at least something in common with hybrids, however defined. The present provisions for the nomenclature of hybrids ignores these facts and can apply only to hybrids as understood by an earlier generation, a limited and nomenclaturally relatively unimportant class of phenomena.

4 Jour. Genet. 20: 405–467, *pl. 11–13*.
5 Medd. Carlsberg Lab. 13:
6 Genetics 10: 278–284.
7 Hereditas 8: 126–130, *pl. 2*.
8 Zeits. Ind. Abst. Vererb.-Lehre 48: 1–85.
9 Genetics 11: 590–604.
10 Genetica 9: 241–278.
11 Jour. Genet. 21: 125–129, *pl. 12*.
12 Ann. Mo. Bot. Gard. 23: 471–483, *pl. 23*.
13 Hereditas 16: 105–154.
14 Genetica 12: 531–538.

Hybridization among natural populations not only accounts for new and stable polyploid races, it creates other and more complex situations which do not involve the production of polyploids. In 1922 Jens Clausen estimated that there were 5,308,376 possible combinations of characters of two species of *Viola* which are known to interbreed freely in nature.[15] How many of these actually exist is not, of course, known; but we must be prepared for any number up to that limit. The rules of nomenclature provide that "when different hybrid forms of the same parentage (pleomorphic hybrids; combinations between different forms of a collective species, etc.) are united in a collective group, the subdivisions are classed under the binary name of the hybrid like the subdivisions of a species under that of a species." What the "binary name of the hybrid" can be in such cases is obscure, since there is not one hybrid but many thousands. But it is worth noting that Wittrock in 1896 applied regular taxonomic techniques to the group of variables in *Viola* above mentioned, naming them as varieties, forms, subforms, and so on—to the number of some 40 groups.[16] This leaves a possible 5,308,336 more to be named within this single hybrid complex by the taxonomists of the future, should they attempt to work under the present rules.

Proof is now available that hybridization can and does produce fortuitous combinations yielding individuals which are able to venture into habitats where neither of the parental types exists; these are often sufficiently fertile that extensive self-perpetuating (and ultimately reasonably stable) populations result (there are examples of this in *Vaccinium*, *Fagus*, *Quercus*[17]). Here no polyploid phenomena are involved; homoploid crossing provides only another of the various mechanisms of evolution. It has been obvious for some time that many species came into being in such a manner in the past; it is equally obvious that it is taking place today in many areas and in diverse groups. Yet the rules of nomenclature under which we now operate force us to ignore this common phenomenon, or to treat it in a wholly unrealistic or inadequate manner. A nomenclatural system must be flexible enough to permit the taxonomist to express, with clarity and precision, the complexity which he finds in nature.

It is now manifest that different kinds of species exist in nature, and subspecific groups that behave in many different ways. A little of this complexity which the taxonomist faces was pointed out by Camp and Gilly in 1943.[18] We have apomictic groups, often in great numbers or "swarms" (as in *Crataegus*,[19] *Crepis*[20]); hybrid swarms (as between *Viola*

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[15] Bot. Tidssk. 37: 363–416.
[16] Acta Hort. Berg. 2¹: 1–142, *pl. 1–14.*
[17] Bull. Torrey Club 72: 1–21; and unpublished work of W. H. Camp.
[18] Brittonia 4: 323–385.
[19] Bot. Gaz. 97: 780–793. Castanea 7: 51–55.
[20] Carn. Inst. Wash. Publ. 504: 1–199.

arvensis and *V. tricolor*[15]); heteromorphic auto- and allopolyploid series which are highly interfertile on the homoploid levels (as in *Vaccinium*[21]); polyploid races morphologically alike which will not interbreed (as in *Tradescantia*,[22] *Sedum*[23]); clines of all sorts (as in *Plantago*,[24] *Fagus*[17]); both small- and large-scale introgressions (as in *Tradescantia*,[25] *Quercus*[17]); and many other phenomena, such as aneuploid series derived by hybridization (as in *Erophila*,[26] *Carex*[27]). Perhaps no rules of nomenclature can serve us in describing and cataloguing such groups, unless the rules themselves become so complex that they defeat their purpose. A set of rules whose applications we attempt to define more and more strictly is certainly insufficiently elastic to adapt itself to the constant expansion of knowledge. And we must face the certain fact that our present knowledge is only a fraction of that yet to be uncovered concerning the extent and character of these phenomena.

However this may be, the present rules, which include provisions which do not, in fact, correspond with what we already know is to be found in nature and do not answer the present needs of the experimental taxonomist or biosystematist, should no longer be tolerated. It is probably beyond the powers of any one or two persons to propose rules to apply to these highly complex phenomena. The lack of proposals for the nomenclature of hybrids which Sprague mentions reflects this difficulty, but is neither a sufficient nor a valid reason for retaining the old rules, these being not only inapplicable and misleading, but based on conceptual error.

Since it is obvious that the portions of the present rules which have to do with "hybrids" and populations derived from hybrid materials are inadequate and need complete revision it is proposed that the ensuing International Botanical Congress establish a special committee charged with the duty of formulating a revision of these parts which will permit all systematists to attack their problems in the light of present knowledge. Such a committee should be composed of descriptive and experimental taxonomists and also include geneticists. Its task will be no easy one, for it will be turning totally new ground in the practice of nomenclature. The alternative is to admit that taxonomy in the traditional sense and modern experimental systematics (biosystematy) have nothing in common —a conclusion detrimental to both branches of biology.

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NOTE: Since the above was written and sent to the printer, a symposium was held at Utrecht, under the auspices of the International Union of Biological Sciences, to discuss proposals made for changes in the rules of nomenclature. At this meeting the nomenclature

21 Brittonia 5: 203–275.
22 Genetics 21: 61–65.
23 Am. Jour. Bot. 29: 283–286.

of hybrids was briefly discussed and a committee was formed to study the matter and to make recommendations to the International Botanical Congress in 1950. The junior author of the present paper was named secretary of that committee, and would be pleased to receive communications on the subject from readers who are interested in it.

[24] New Phytol. **38**: 293–322.
[25] Ann. Mo. Bot. Gard. **23**: 515–525.
[26] Medd. Carlsberg Lab. **23**: 41–74.
[27] Hereditas **5**: 129–216. Brittonia **4**: 340.

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SYNERGISM BETWEEN SOME ANTIBACTERIAL SUBSTANCES[1]

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In the course of an investigation of antibacterial substances produced by some Basidiomycetes, phenomena were observed which indicated that the activity of one antibacterial substance might be enhanced by the presence of a second antibacterial substance.

The results to be described were originally observed when agar discs containing an antibacterial substance or discs cut from fungus colonies growing on an agar medium were placed on yeast-peptone agar, seeded with the indicator bacteria, at such distances that the zones of antibacterial action produced by the discs touched or merged. In addition to the observations made on agar plates, experiments were conducted in broth cultures as described below.

Methods and Materials. The indicator organisms included *Staphylococcus aureus* (II), *Sarcina lutea, Bacillus subtilis,* and *Bacillus mycoides.* The antibacterial substances were penicillin, streptomycin, and streptothricin, which were incompletely purified materials kindly supplied by Merck & Co., Inc.; an antibacterial substance from burdock (*Arctium minus;* 2) obtained from Dr. J. H. Bailey; patulin, which was generously furnished by Dr. H. Raistrick (1), and tolu-p-quinone.

The fungi (5, 6, 7) used included: *Pleurotus griseus* (No. 14616R), *Poria corticola* (No. 71280), *Poria tenuis* (No. 67942), *Corticium* sp. (No. 14572R[2]), and *Polyporus biformis* (No. 71423R). The antibacterial substances produced by *Poria corticola, Polyporus biformis,* and *Corticium* sp. 14572R are different from one another and different from the other antibiotic substances included in this investigation.[3] The antibiotic material produced by *P. tenuis* is similar to that of *P. corticola.*

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[1] This investigation was supported in part by grants from the Commonwealth Fund and the Lillia Babbitt Hyde Foundation.

[2] This fungus is listed in previous papers as *Corticium abeuns.* Dr. H. S. Jackson has determined the fruit body collected when the fungus was isolated to be that of *Corticium ochraceum.* It is possible, however, that the mycelium which was isolated was not that which formed the fruiting body. Until sporophores can be produced in culture, the identity of this fungus is uncertain.

[3] The terms antibacterial and antibiotic may need elucidation. Any substance which inhibits the development of bacteria may properly be called an antibacterial substance. For the purpose of this paper, an antibiotic substance is defined as a soluble organic substance produced by an organism and markedly inhibitory to the growth or activity of one or more living organisms. Oxford (4) required an antibiotic substance to produce

For the agar disc tests, the fungi were grown in petri dishes on a modified Czapek-Dox agar medium containing corn steep solids (5). The antibacterial substances were made up in 1.5 per cent water agar. Discs 5.5 mm. in diameter were cut from the fungus colonies and underlying agar or from the water agar in which the antibacterial substances were dissolved. The discs were placed on the surface of yeast-peptone agar (5) freshly seeded with the indicator organisms and the petri dishes were incubated at a suitable temperature.

For the liquid cultures, a subminimal concentration of one antibiotic preparation was added to each tube of a set in which the activity of a second was determined for *Staph. aureus* by serial dilution (3). A comparison of the maximum dilution at which the mixture evidenced inhibition with that for the one preparation alone formed the basis for judging the degree of synergism.

Experimental Results. *Disc Tests.* The phenomenon with which we are concerned is illustrated in figure 1, A. In this experiment, agar discs containing approximately 50 μg. of streptomycin per ml. and discs cut from a colony of *P. corticola* were tested on yeast-peptone agar seeded with *B. mycoides* and incubated at 30° C. The streptomycin disc (lower left in fig. 1, A) produced in inhibition zone 12 mm. in diameter spotted with resistant colonies; the disc of *P. corticola* (lower right, fig. 1, A), an inhibition zone 28 mm. in diameter. The inhibition caused by *Poria* was partial; numerous small and a few larger colonies were present in the inhibition zone, few near the center and more toward the edge forming a "bull's-eye." We believe that these colonies were not composed of a strain of *B. mycoides* resistant to the antibiotic materials from *P. corticola* but were mainly colonies the development of which was interfered with but not prevented by the antibiotic material.

When the discs were placed so that their edges were 11 mm. apart, the colonies which would be expected to appear between the two discs did not develop. Visible antibacterial action of the streptomycin, which extended 3 mm. from the edge of the disc when it acted alone, was evidenced to a distance of 11 mm. from the edge of the disc containing streptomycin when in the presence of the antibacterial materials from *P. corticola*. The discs of *P. corticola*, which partially inhibited the bacteria up to a distance of 11 mm. from the edge of the disc when alone, induced action at a distance of 16 mm. in the presence of streptomycin as shown by the elimination of resistant colonies in the vicinity of the streptomycin disc. Streptomycin, at

a measurable effect *in vitro* at a concentration of the order of 50 parts per million or less. All the substances tested in the work described in this paper are antibacterial; not all can properly be referred to as antibiotic substances either because of their origin (tolu-p-quinone) or of the concentrations at which they are active (acetic acid).

concentrations below the inhibitory level, intensified the action of the substances formed by *P. corticola,* and the antibacterial substances from the fungus had a similar, though perhaps less marked, effect upon the activity of streptomycin. The subminimal inhibitory concentrations of the antibacterial materials from *P. corticola* were effective by eliminating colonies of

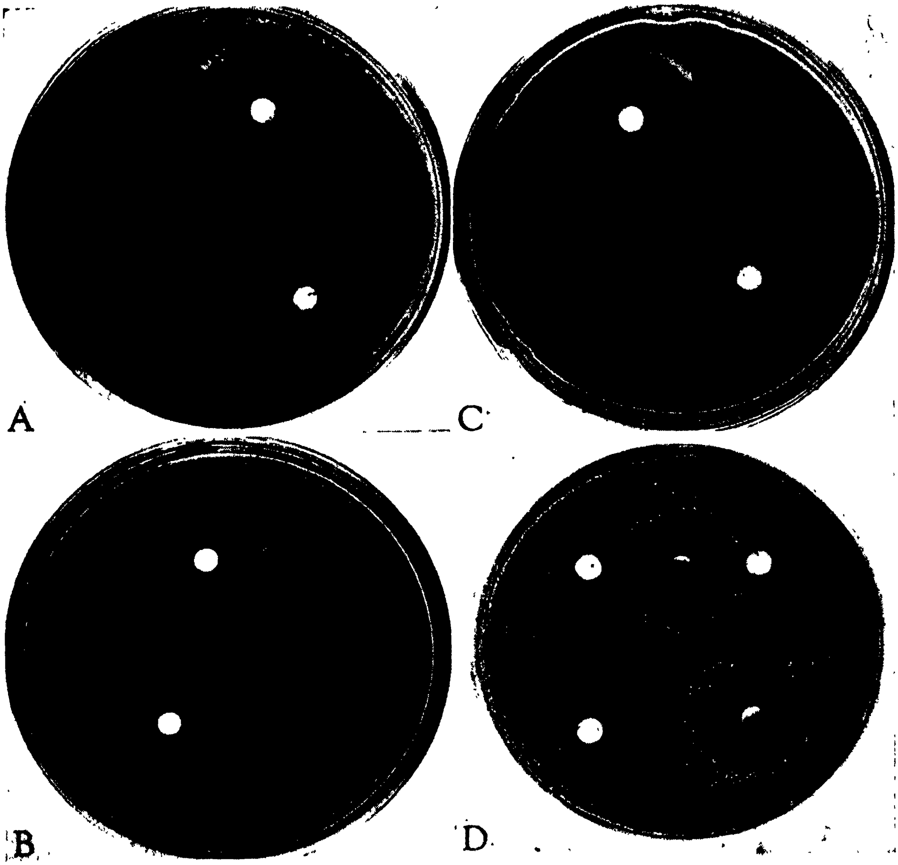

FIG. 1-. Agar discs cut from colony of *Poria corticola* and agar discs containing streptomycin tested on yeast-peptone agar against: A. *Bacillus mycoides* at 30° C; B. *Staphylococcus aureus* at 37° C; C. *Bacillus subtilis* at 30° C; and D. *Sarcina lutea* at 30° C. The fungus discs can be distinguished by the white mycelium which covers the surface of the discs. Note marked synergism between streptomycin and *Poria corticola* for *Bacillus mycoides* and *Staphylococcus aureus,* less for *Bacillus subtilis* and little or none for *Sarcina lutea.*

bacteria resistant to streptomycin and subminimal inhibitory concentrations of streptomycin acted by preventing the development of colonies which were partially inhibited by the fungus.

Results with Other Bacteria. Much the same interaction between strep-

tomycin and the antibacterial material formed by *P. corticola* was observed on *Staph. aureus* grown at 36° C (fig. 1, B); to a lesser degree on *B. subtilis* grown at 30° C (fig. 1, C) and on *Sar. lutea* grown at 30° C (fig. 1, D).

There was some relation between the occurrence of resistant colonies or partial inhibition and the intensity of the synergistic effect. For example, the inhibition produced by the discs of *P. corticola* was partial when the plates were seeded with *Staph. aureus* or *B. mycoides*. The mutually intensifying action of streptomycin and the antibacterial substances from *Poria* on these two bacteria was marked. Furthermore, the synergistic action was confined to the areas where partial inhibition of the bacteria occurred or colonies of resistant bacteria were evident when the antibacterial substances acted individually. Partial inhibition or the presence of resistant colonies was less evident when the plates were seeded with *Sar. lutea* or *B. subtilis* and the synergistic action was less obvious.

The pattern between the discs varied with the indicator bacteria and with the antibiotic substances as illustrated in figures 1, 2, and 3, A.

In the experiment illustrated in figure 2, discs containing approximately 50 μg. of streptothricin per ml. and discs from a colony of *P. corticola* were used. The plate illustrated in figure 2, A, was seeded with the stock strain of *Staph. aureus* and the edges of the discs were 11.5 mm. apart. The plate illustrated in figure 2, B, was seeded with a strain of *Staph. aureus* resistant to the antibacterial material from *Corticium* sp. 14572R. This strain was derived from the stock. The edges of the discs were 15.7 mm. apart. The synergistic pattern for both strains of *Staphylococcus* is similar. The elimination of colonies of bacteria resistant to streptothricin by subminimal inhibitory concentrations of the antibacterial material from *Poria* is evident (especially in figure 2, B). The elimination of organisms (partially affected by the antibiotic material from *Poria*) by subminimal inhibitory concentrations of streptothricin is also clear.

The pattern was influenced also by the distance between the two discs. For example, discs of agar containing streptomycin were placed on each side of a mycelial disc of *P. corticola* but at different distances (fig. 1, B). The pattern of synergistic action between the *Poria* disc and the nearer of the two discs containing streptomycin differed from that where the separation was greater. As a result, the partially inhibited colonies of *Staph. aureus* unaffected by the streptomycin, formed two strips above and below the disc from the fungus which were tipped toward the more distantly located disc containing streptomycin.

When *Staph. aureus* or *B. mycoides* were used as indicator organisms and the discs of *P. corticola* and streptomycin were sufficiently far apart, a half-moon-shaped area of nearly complete inhibition in the midst of an area of partial inhibition was observed. The horns of the half-moon were turned

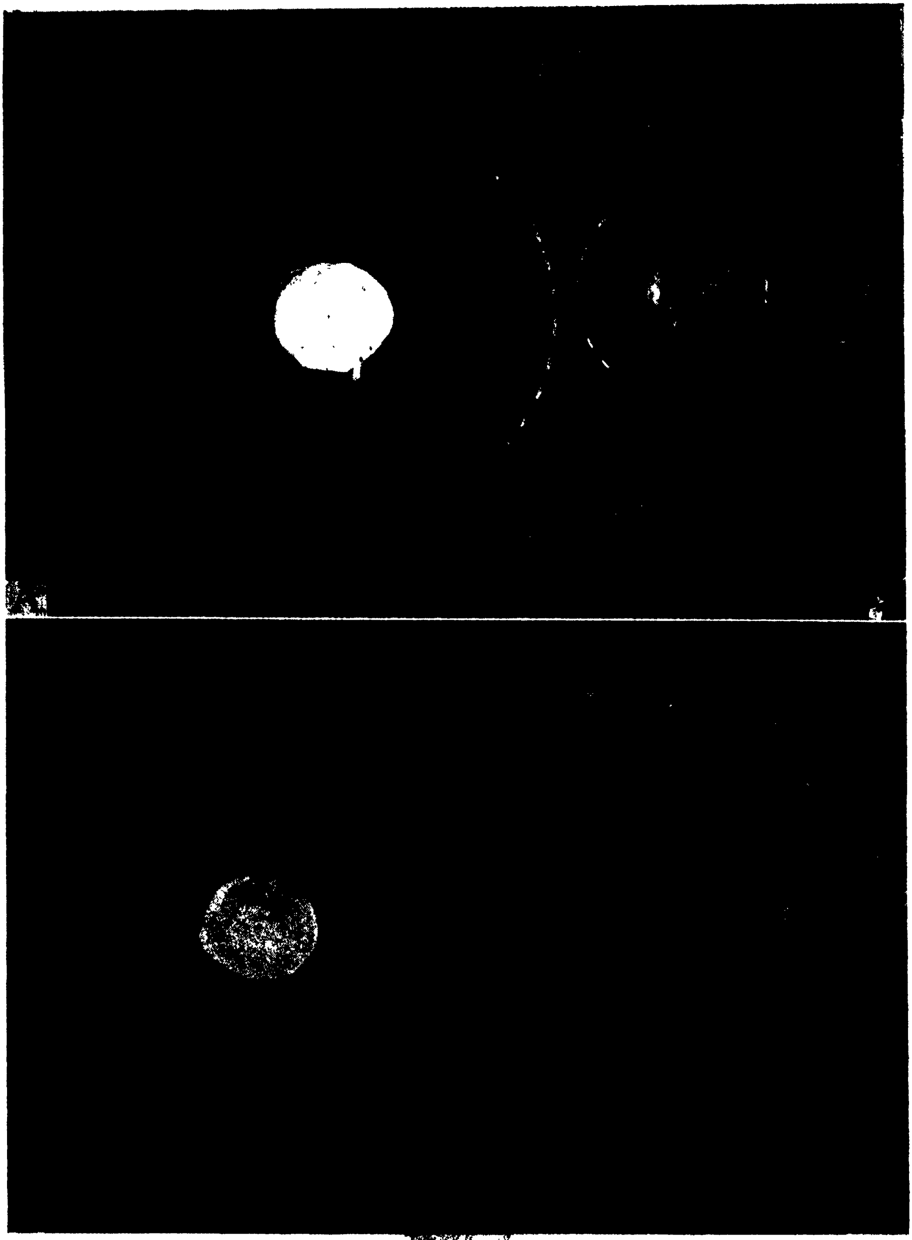

FIG. 2. A. Disc from *Poria corticola* (left) and disc containing streptothricin (right) on yeast-peptone agar seeded with stock *Staphylococcus aureus*. B. Disc from *Poria corticola* (left) and disc containing streptothricin (right) on yeast-peptone agar seeded with strain of *Staphylococcus aureus* resistant to the antibiotic material from *Corticium* sp. 14572R. The limits of action of the antibacterial material from each disc if it acted alone is given by the dotted circles.

toward the disc from the fungus colony. It appeared that the antibacterial substances from the fungus were of insufficient concentration to intensify the activity of the streptomycin in the area between the half-moon and the disc containing streptomycin. On the other hand, the concentration of streptomycin was insufficient to affect materially the antibacterial substances

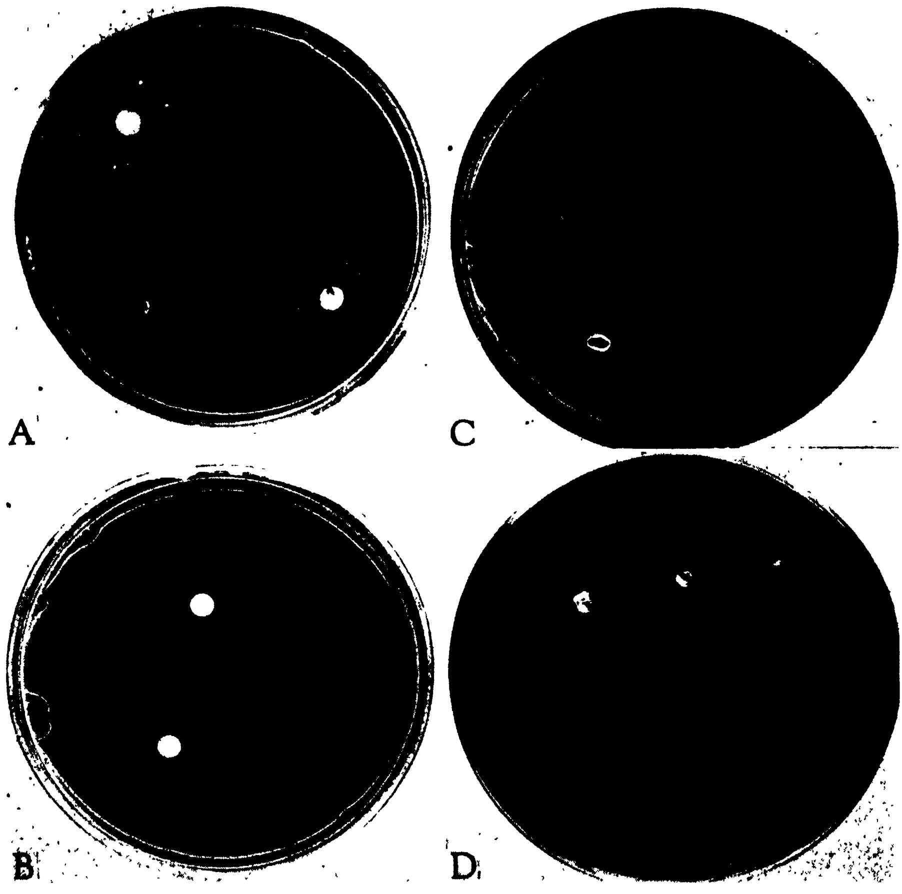

FIG. 3. A. Agar discs containing streptomycin (toward center of plate) tested against *Staphylococcus aureus* with discs from colony of (upper left) *Corticium* sp. 14572R, (upper right) *Poria corticola*, (lower right) *Pleurotus griseus*, and (lower left) *Poria tenuis*. B. Discs from colony of *Poria corticola* and agar discs containing streptomycin tested on yeast-peptone agar at pH 8.0; seeded with *Bacillus subtilis*. Compare with figure 1. C. Agar discs containing streptomycin (toward center of plate) tested against *Staphylococcus aureus* with (upper left) agar disc containing 12 per cent KH_2PO_4, (upper right) agar disc containing 12 per cent $KHCO_3$, and (lower center) agar disc containing 10 per cent acetic acid. D. Above, discs from colony of *Poria tenuis*; below, agar discs containing penicillin. Strip of agar removed from plate at initiation of experiment. Note spread in activity where antibacterial zone touches agar edge.

from the *Poria* in the area between the half-moon and the *Poria* disc. In the half-moon where inhibition was nearly complete, each of the two substances was present in suitable concentration to effect a degree of inhibition of *Staph. aureus* neither caused when acting alone. A similar result was noted for other antibiotics, for example, patulin and the antibacterial substances from *P. corticola.*

Hydrion Concentration. The activity of streptomycin is greater in alkaline than in acid solution. Was the increased antibacterial activity observed between discs of *P. corticola* and discs containing streptomycin due to a change in the hydrion concentration of the medium induced by the fungus discs? This does not seem probable, because the discs of *P. corticola* were acid, not alkaline. Furthermore, the effects varied with the indicator organism; they were marked for *Staph. aureus* and *B. mycoides* and much less so for *B. subtilis* and *Sar. lutea.* If the apparent synergesis were the result of pH changes induced by the mycelial discs, we would rather expect them to appear irrespective of the indicator organism.

Further evidence that pH changes were not responsible for the effects observed, was obtained from the following experiments.

The yeast-peptone medium which had a pH of 6.5 was adjusted by the addition of NaOH to pH 8.0 and the mutual effects of discs containing streptomycin and discs of *P. corticola* were determined with *Staph. aureus* and *B. subtilis* as the indicator bacteria. The synergistic action between streptomycin and the antibacterial substances from *P. corticola* was observed on the alkaline medium (fig. 3, B).

Discs were prepared containing 12 per cent KH_2PO_4, 12 per cent $KHCO_3$, and 10 per cent acetic acid. The effect of these discs on the activity of discs containing streptomycin was tested on yeast-peptone agar with *Staph. aureus* as the indicator organism (fig. 3, C). The KH_2PO_4 reduced the activity of streptomycin, the $KHCO_3$ increased it and the effect was greater toward the disc of $KHCO_3$. However, the alkalinity induced by 12 per cent $KHCO_3$ was far beyond any pH change which might be induced by the mycelial discs which have little or no effect in the reaction of the yeast-peptone medium. Other experiments on the interaction of discs containing $KHCO_3$ and streptomycin with *Staph. aureus* and with *Sar. lutea* as the indicator organisms led to the same conclusion.

The acetic acid was quite inhibitory. Because of the wide zone of action of the acetic acid, its influence on streptomycin in this experiment (fig. 3, C) was not determined. However, the acetic acid showed a greater effect than was anticipated at the edge of the plate. Instead of forming a circle, the zone of inhibition was extended at the plate edge. This edge effect was further investigated.

Edge Effect. In the experiment described previously, an extension of

the antibacterial action of acetic acid was noted at the edge of the petri dish. An edge effect was noted also with penicillin, the antibacterial substances from *P. tenuis,* and tolu-p-quinone. It was evident at an agar edge (fig. 3, D) as well as at the edge of a petri dish. It was affected by the depth of the medium on which the discs were tested. The edge effect was more pronounced in dishes containing 18 ml. of medium than in dishes with 36 ml. of medium. The edge effect is probably the result of an accumulation of the antibacterial substance at a boundary which interferes with or prevents free diffusion.

Interaction between Other Antibacterial Substances. The interaction between mycelial discs of several fungi, antibacterial concentrates prepared from culture liquids of some of them, and known antibiotic substances was investigated. *Staph. aureus* incubated at 36° C was used as the indicator organism. Positive action was noted for some combinations and none for others (table 1). In addition to the combinations given in table 1, positive results were obtained between tolu-p-quinone and the antibiotic substance from burdock, and between streptomycin and an extract of the leaves of *Cassia reticulata* (8). Negative results were obtained for streptomycin and mycelial discs of *Trametes serpens.*

TABLE 1. *Synergism for Staphylococcus aureus on yeast-peptone agar between agar discs of the fungi or antibacterial preparations noted.*
The occurrence of synergism is noted by the + sign.

	71280 *Poria corticola,* mycelial discs	69742 *Poria tenuis,* mycelial discs	*Corticium* sp. 14572R, mycelial discs
Corticium sp. 14572R, mycelial discs	+++	+++	No test
Corticium sp. 14572R, concentrate from culture liquid	+	+	No test
Patulin	++	++	+
Streptomycin	+++	+++	+
Streptothricin	+++	+++	No test
Pleurotus griseus, mycelial discs	0	0	+
Pleurotin	0	0	No test
Polyporus biformis, mycelial discs	0	0	+
Antibiotic substance from burdock	0	0	No test
Penicillin	0	0	No test
Tolu-p-quinone	0	0	No test
Poria corticola, mycelial discs	No test	0	+++
Poria tenuis, mycelial discs	0	No test	+

Experiments in Broth Cultures. The synergistic action between streptomycin and culture liquids of *P. corticola* and *P. tenuis* was tested in a number of experiments in beef extract or yeast-peptone broth. An amount

of streptomycin below the minimum necessary to inhibit the growth of *Staph. aureus* was added to each tube in a set in which the activity of the culture liquid of the fungus was determined by serial dilution. The maximum dilution at which the culture liquid evidenced inhibition was compared with that found for the culture liquid assayed in the presence of a subminimal concentration of streptomycin. Conversely, a subminimal inhibitory concentration of the culture liquid was used in a serial dilution test of streptomycin.

Experiments were carried out in beef extract and in yeast-peptone broth. Positive results were obtained. In one experiment, one-quarter of the minimal inhibitory concentration of streptomycin increased the activity of the culture liquid of *P. corticola* two times, and one-half the minimal inhibitory concentration increased it 16 times. In other experiments, the effect was less or none. Similarly, one-fourth the minimal inhibitory concentration of the culture fluid of *P. corticola* doubled the activity of streptomycin in one experiment.

Positive results were more consistently obtained in liquid cultures when subminimal inhibitory concentrations of streptomycin were used in a serial dilution test with the culture fluid from *P. corticola* than when the reverse combination was made. The reasons for this are not clear. However, variations in pH and the concentration of the antibiotic substances (that of the one used in subminimal amount in particular) were found to be important factors in determining synergism in liquid cultures.

Discussion. The synergistic effects reported above may be ascribed in part to the occurrence in a stock culture of individuals resistant to a particular antibiotic substance but susceptible to a second and different antibacterial material. The antibiotic material from *P. corticola* (at a concentration which evidenced no obvious effect on the mass of bacteria in an agar plate) was observed to eliminate colonies resistant to streptomycin. We would expect, therefore, to find that a strain of *Staph. aureus*, for example, resistant to streptomycin would be inhibited by a greater dilution of the culture liquid of *P. corticola* than the stock from which the resistant strain was derived.

The phenomenon of partial inhibition is important also in determining synergism. For example, the antibacterial material from *P. corticola* when sufficiently dilute does not completely inhibit the development of *Staph. aureus* but interferes with it. At such a dilution, the liquid is bacteriostatic but only partially so, with the result that many small colonies are present on an agar plate in the zone of inhibition surrounding a disc of mycelium of the fungus. In a serial dilution series, the tubes in which the greater concentration of antibiotic material occurs and complete inhibition is found are followed by those in which there is partial inhibition as evidenced either

by a precipitation of the bacteria or by less growth or both. These organisms which are affected to some extent by the antibacterial material from *P. corticola* are rendered more susceptible to the action of subminimal inhibitory concentrations of streptomycin.

If our interpretation of the experiments described here is correct, synergistic action of antibiotic substances might occur either because of the elimination of resistant organisms or because organisms already weakened to some degree by one antibiotic substance become more susceptible to a second. In any event, it would appear desirable to pursue investigations of this type further and to include in the evaluation of antibiotic substances those which are only partially effective in inhibiting the growth of particular bacteria.

SUMMARY

One antibiotic substance was found to evidence synergistic action on another depending upon the substances concerned and the indicator bacteria used. The phenomenon was observed when agar discs were placed near one another on an agar plate seeded with the indicator bacteria. The synergistic action was noted in liquid culture also. It is associated with the elimination of organisms resistant to one antibiotic substance but not to another or with an intensification by one antibiotic substance of a partial inhibition induced by another.

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Literature Cited

(1) **Anslow, W. K., Raistrick, H., & Smith, G.** Anti-fungal substances from moulds. Part I. Patulin (anhydro-3-hydroxy-methylenetetrahydro-1: 4 pyrone-2-carboxylic acid). A metabolic product of *Penicillium patulum* Baimer and *Penicillium expansum* (Link) Thom. Jour. Soc. Chem. Ind. **62**: 236–238. 1943.

(2) **Cavallito, C. J., Bailey, J. H., & Kirchner, F. K.** The antibacterial principle of *Arctium minus*. Jour. Am. Chem. Soc. **67**: 948–950. 1945.

(3) **Kavanagh, Frederick.** Estimation of antibacterial substances by serial dilution methods. Bull. Torrey Club **74**: 303–320. 1947.

(4) **Oxford, Albert E.** The chemistry of antibiotic substances other than penicillin. Ann. Rev. Biochem. **14**: 749–767. 1945.

(5) **Robbins, William J., Hervey, Annette, Davidson, Ross W., Ma, Roberta, & Robbins, William, C.** A survey of some wood-destroying and other fungi for antibacterial activity. Bull. Torrey Club **72**: 165–190. 1945.

(6) **Robbins, William J., Kavanagh, Frederick, & Hervey, Annette.** Antibiotics from Basidiomycetes I. *Pleurotus griseus*. Proc. Nat. Acad. **33**: 171–176. 1947.

(7) **Robbins William J., Kavanagh, Frederick, & Hervey, Annette.** Antibiotic substances from Basidiomycetes. II. *Polyporus biformis*. Proc. Nat. Acad. **33**: 176–182. 1947.

(8) **Robbins, William J., Kavanagh, Frederick, & Thayer, J. D.** Antibiotic activity of *Cassia reticulata* Willd. Bull. Torrey Club **74**: 287–292. 1947.

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TAXONOMIC AND CYTOLOGICAL NOTES ON THE ANNUAL SPECIES OF HELIANTHUS

CHARLES B. HEISER, JR.

Helianthus, a genus of the Compositae, comprises approximately one hundred species. Although a few species are found in South America, its distribution is primarily North American. The majority of species in the genus are perennials. Gray (1884) recognized only six species and two varieties of annual sunflowers. Cockerell (1915), who studied the annual sunflowers for a number of years, recognized "at the most nine species which can probably be reduced to five." E. Watson (1929), in his contributions to a monograph of the genus, included ten annual species in the genus, two of which were described as new. Blake (1931) described *H. anomalus*, which subsequently was found to be an annual. Another new species is described in the present paper.

I have grown several species of annual sunflowers for a number of years, examined the material in several herbaria, and made field observations in many regions. On the basis of these studies I would be inclined to recognize nine species. These are as follows: *H. annuus* L., *H. petiolaris* Nutt., *H. debilis* Nutt., *H. argophyllus* Torr. & Gray, *H. Bolanderi* A. Gray, *H. agrestis* Pollard, *H. praetermissus* E. E. Wats., *H. anomalus* Blake, and *H. Jaegeri*, described below.

My interpretation differs from Watson's (1929) in that I would consider *H. canus* (Britton) Wooton & Standley as merely a variety of *H. petiolaris* (*H. Petiolaris* var. *canescens* A. Gray) and *H. cucumerifolius* Torr. & Gray a variety of *H. debilis* (*H. debilis* var. *cucumerifolius* A. Gray). Watson's *H. vestitus* is probably merely a form of *H. debilis* with a hirsute stem and should be included within that species.

Watson's *H. praetermissus* is known only from the type collection of the Sitgreaves Expedition at Rio Laguna (Valencia County), New Mexico. The specimen described by Watson (p. 335, Pl. XLVII) probably represents a depauperate individual, for I have examined an isotype from the Gray Herbarium which has much larger leaves (12 cm. in length; 2–3 cm. in width) and a branched rather than a simple inflorescence.

During my investigation of the annual sunflowers of California in 1946, Dr. Lyman Benson sent me an undetermined *Helianthus* which he thought might be of interest. Subsequent study showed that this specimen represented a new species in the genus and accordingly is described below.

Helianthus Jaegeri Heiser, sp. nov. Herba annua, caulibus superne ramosis, sparse hispidis, foliis alternatis petiolatis lamina lanceolata basi cuneata serrulata ad 15 cm. longa 10 cm. lata hispida pilis brevibus, involucro 2-seriato, bracteis ovato-lanceolatis hispidulis 3–4 mm. latis apice attenuatis patulo-squarrosis disco 1.5–2.0 cm. diam., paleis receptaculi 3-cuspidatis arista media longa lanceolataque, ad apicem purpurea hispidaque, radiis flavibus ca. 10–15 ca. 2 cm. longis 6–7 mm. latis; corollis disci 5–6 mm. longis, angustis basi leviter dilato-bulbosis lobis purpureis, achaeniis ca. 5 mm. longis 2 mm. latis leviter pilosis, squamis pappi 2 angusto-lanceolatis ca. 3 mm. longis.

TYPE: California, San Bernardino County: swampy areas near Soda on border of Soda Dry Lake. Soil: sodium sulfate. Sept. 25, 1946. *Edmund C. Jaeger s. n.* (Pomona College, no. 270144).

The root is not included on the type specimen, and at first I thought that the plant might be a perennial. However, it was quite unlike any of the perennials of that region, and I wrote Dr. Benson if it would be possible to secure information regarding the habit of the plant. Mr. Jaeger then revisited the region and found that all the old roots were dead and that plants were coming up from seed. The new species is named for Mr. Jaeger, who has long been a student of desert life of California.

The new sunflower presents no features unknown in other species of the genus, but the combination of features is quite unlike that of any other annual. It is perhaps worth while to point out the characters by which it is most readily distinguished from the annual sunflowers of southern California, although none of these are known to occur in the vicinity of the new species. From *H. annuus* it is distinguished at once by the smaller heads, the narrower leaves and involucral bracts, and from *H. petiolaris* by lacking the dense white pubescence of the central pales of the chaff.

Seeds from the type specimen were planted in the greenhouse at Davis in December of 1946 with a number of other annual species. However, the plants of *H. Jaegeri* had not produced buds by May, at which date (the plants of) *H. annuus, H. petiolaris*, and *H. Bolanderi* were in flower. The plants of *H. Jaegerii* were then transplanted to the field and finally bloomed in late August. I am greatly indebted to Mr. Walter Russell for securing buds of these plants for cytological analysis.

The basic chromosome number of the genus *Helianthus* is seventeen (Geisler 1931; Darlington & Janaki Ammal 1945), and all the species thus far investigated possess this number with the exception of three hexaploid perennial species. The counts known for the annuals, including those presented in the present paper, are given in table 1.

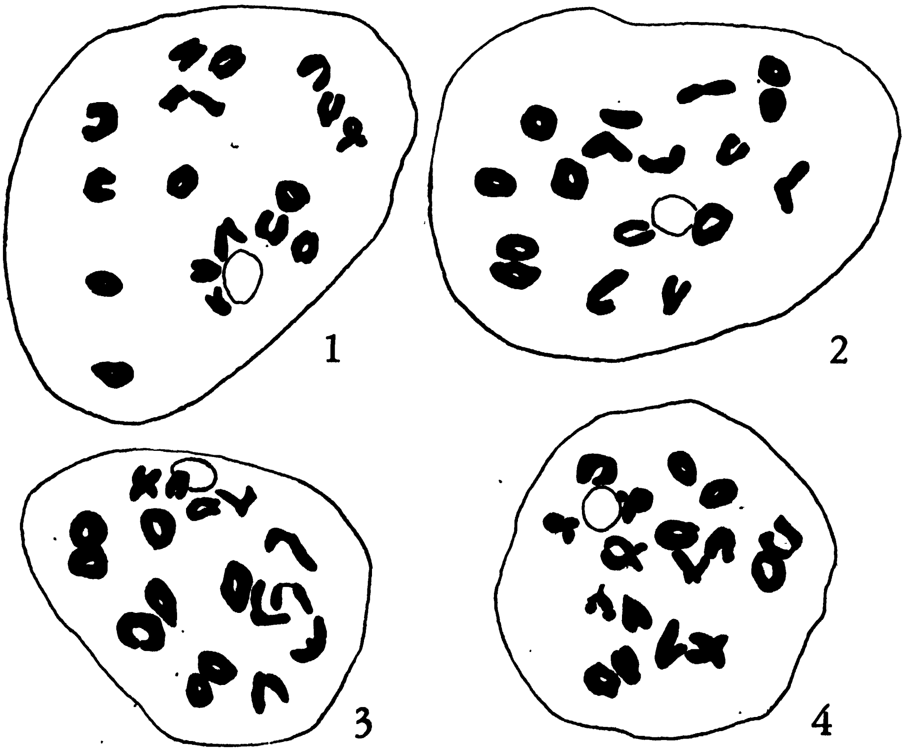
The three counts given here for the first time were all from microsporocytes smeared in aceto-carmine. The buds for the smears of *H. Jaegeri* were taken from plants grown from seed of the type specimen; buds of *H. petiolaris* var. *canescens* were obtained from plants grown from seed col-

TABLE 1. *Chromosome numbers in the annual species of Helianthus*

Species	Number *n*	Number 2*n*	Authority*
H. annuus L.		34	Tahara 1915
	17		Kostoff 1939
H. argophyllus T. & G.	17		Present paper
H. Bolanderi A. Gray	17		Heiser 1947a
H. debilis var. *cucumerifolius* (T. & G.) A. Gray		34	Kihara, Yamamoto, and Hosono 1931
	17		Wagner 1932
H. Jaegeri Heiser	17		Present paper
H. petiolaris Nutt.	17		Heiser 1947b
H. petiolaris var. *canescens* A. Gray	17		Present paper

* The bibliography includes the earliest reference which I have been able to locate.

lected by Dr. Frank Gould near Tucson, Arizona; and buds of *H. argophyllus* were from plants grown from seed taken from a herbarium specimen at the University of California (*Cory 51242* collected in San Patricio County, Texas). The specimens upon which my counts are based have been deposited in the herbarium of Indiana University. All three species



Figs. 1–4. Camera lucida drawings of chromosomes of *Helianthus* and *Tithonia*. Approximately × 1250. Fig. 1. *H. argophyllus*. Fig. 2. *H. Jaegeri*. Fig. 3. *H. petiolaris* var. *canescens*. Fig. 4. *T. rotundifolia*.

have the haploid count of seventeen (figs. 1–3). Behavior of the chromosomes at meiosis in *H. argophyllus* and *H. petiolaris* var. *canescens* appeared normal. In the material of *H. Jaegerii*, in eight of the fifty cells studied, chains of four chromosomes and fifteen pairs were observed instead of the normal seventeen pairs. However, the presence of chains resulted in little or no sterility. Pollen slides showed that over 90 per cent of the grains were stainable.

For the genera closely related to *Helianthus* (*Viguiera*, *Tithonia*, etc., see Blake 1918) no chromosome counts have been reported. I have secured a count of seventeen pairs (fig. 4) for *Tithonia rotundifolia* (Mill.) Blake; (*Tithonia speciosa* Hook. of horticulturists) from cultivated material. The number seventeen has not been reported for any other genera of the tribe Heliantheae of the Compositae so far as I am aware.

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Literature Cited

Blake, S. F. 1918. A revision of the genus *Viguiera*. Contr. Gray Herb. **54**: 1–205. 1918.

————. 1931. Nine new American Asteraceae. Jour. Wash. Acad. **21**: 325–336.

Cockerell, T. D. A. 1915. Specific and varietal characters in annual sunflowers. Am. Nat. **49**: 609–622.

Darlington, C. D. & Janaki Ammal, E. K. 1945. Chromosome Atlas of Cultivated Plants. London.

Geisler, F. 1931. Chromosome numbers in certain species of *Helianthus*. Butler Univ. Bot. Stud. **11**: 53–62.

Gray, Asa. 1884. Synoptical flora of North America, Vol. 1, part 2. New York.

Heiser, C. B. 1947a. Variability and hybridization in the sunflower species *Helianthus annuus* and *H. Bolanderi* in California. Ph.D. Thesis (unpubl.) Univ. of Calif., Berkeley.

————. 1947b. Hybridization between the sunflower species *Helianthus annuus* and *H. petiolaris*. Evolution **1**: 249–262.

Kihara, H., Yamamoto, Y. & Hosono, S. 1931. A list of chromosome-numbers of plants cultivated in Japan. Tokyo. (repr. from Skokubutsu Senshokutasisû no Kenkyû.)

Kostoff, D. 1939. Autosyndesis and structural hybridity in F_1-hybrid *Helianthus tuberosus* L. × *Helianthus annuus* L. and their sequences. Genetica **21**: 285–299.

Tahara, M. 1915. Cytological investigation on the root-tips of *Helianthus annuus*, with special reference to the behavior of the nucleolus. Bot. Mag. Tokyo **29**: 1–5.

Wagner, S. 1932. Artkreuzungen in der Gattung *Helianthus*. Zeits. Indukt. Abstamm.-Vererb.-lehre **61**: 76–146.

Watson, E. E. 1929. Contributions to a monograph of the genus *Helianthus*. Pap. Mich. Acad. **9**: 305–475.

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POLLEN GRAIN CHARACTERS OF CERTAIN CACTACEAE

EDWIN B. KURTZ, JR.

A study of the pollen grains of cacti native to Arizona shows that the grains are of two forms. Each basic form can be further subdivided by size, sculpturing of exine, and number and position of germ pores, so that the genera, subgenera, and some species may be distinguished by their pollen grains. For this study pollen samples were obtained from plants growing locally, and from herbarium specimens. I am greatly indebted to Dr. F. W. Gould for the use of the University of Arizona Herbarium, Tucson, Arizona, and to R. H. Peebles for the use of the excellent collection of cactus material in the Herbarium at Sacaton, Arizona. I wish also to thank Dr. W. S. Phillips for his kind suggestions and interest in all phases of this study. All pollen was mounted in glycerin jelly and stained either with methyl-green which made the ridge schemes especially clear, or with aqueous fuchsin which brought out the sculpturing of the exine. This method of mounting expanded the grains completely and examination and measurements were made from the expanded grains in polar view. The pollen characters observed are presented in the following keys and discussions.

Grain spheroidal; all grains tricolpate or a mixture of tricolpate and mono-, di-, tetra-, and nonacolpate (*Echinocereus pentalophus* may be dodecacolpate); exine pitted. . ... *Cereus, Echinocactus, Mammillaria, Echinocereus.*
Grain dodecacolpate; cube and dodecahedron[1] or a variation of this usually with more than 18 faces, or tending to be a spherical and regular cube and dodecahedron with outline of faces indistinct (*Opuntia*).
  Grain spherical, cube and dodecahedron; tetragons and hexagons not distinct; ridges not raised, usually wide; exine pitted; pores circular. *Opuntia* subg. *Cylindropuntia.*
  Grain a perfect cube and dodecahedron or a variation of it; ridges raised; tetragons and hexagons distinct; exine reticulate. *Opuntia* subg. *Platyopuntia.*

CEREUS, ECHINOCACTUS, MAMMILLARIA, ECHINOCEREUS

Grain tricolpate; spheroidal; 41–82 μ in diameter; exine finely pitted and in some species, especially *Cereus Schottii*, minutely spiney (spines up to 1.5 μ high). In pollen samples of each species most grains are tricolpate, but many mono-, di-, tetra-, penta-, hexa-, and nonacolpate grains also occur. The furrows of tricolpate grains are long, usually narrow, and approach within 5–10 μ of the poles. As the number of furrows increases the

[1] A cube and dodecahedron is a solid with six squares and twelve hexagons.

furrows become progressively shorter (fig. 3). Of special interest are the grains of *Echinocereus pentalophus* which may be the typical tricolpate type, but many grains are large (67 μ) and dodecacolpate; that is, with twelve short, equally spaced furrows so arranged that their axes converge toward eight triradiate centers. These grains rather closely resemble pollen of *Opuntia leptocaulis* or similar *Opuntia* pollen, and may indicate a possible relationship. Furrow margins of *Cereus, Echinocactus, Mammillaria, Echinocereus* pollen may be distinct or fringed with overlapping exine. Germ pores are not visible. Expansion of grains is accomplished by the evagination of the furrows from the dry state in which the furrows are slightly to deeply invaginated. Germinal furrows may be flecked, granular, or smooth, but this is usually not constant for a species.

Identification of genera and species on the basis of their pollen seems impracticable, although if the genus is previously known, pollen size may be useful in ascertaining the species, as in distinguishing long-spined forms of *Echinocereus coccineus* from *Echinocereus polyacanthus*. Pollen measurements in this group are as follows:

Echinocactus (fig. 3)

48–50 μ—*E. Lecontei* Engelm.
49–51 μ—*E. Wislizenii* Engelm.
50 μ—*E. Covillei* (Britt. & Rose) Berger
50 μ—*E. longihamatus* Galeotti
55 μ—*E. acanthodes* Lemaire
58–59 μ—*E. intertextus* Engelm.
62 μ—*E. Sileri* Engelm.
62–65 μ—*E. polyancistrus* Engelm. & Bigel.
57–65 μ—*E. Whipplei* Engelm. & Bigel.
67 μ—*E. erectocentrus* Coulter
73 μ—*E. Johnsonii* Parry
71–79 μ—*E. horizonthalonius* Lemaire

Mammillaria

43–50 μ—*M. vivipara* Engelm.
52–54 μ—*M. deserti* Engelm.
53–54 μ—*M. microcarpa* Engelm.
58–59 μ—*M. Alversonii* (Coulter) Zeissold
60–63 μ—*M. arizonica* Engelm.

Cereus

50–55 μ, mostly 50 μ—*C. giganteus* Engelm.
58–61 μ—*C. Schottii* Engelm.
65–69 μ—*C. Thurberi* Engelm.
68–82 μ—*C. Greggii* Engelm.

Echinocereus

41–55 μ—*E. mojavensis* (Engelm. & Bigel.) Rumpler
45–60 μ—*E. Ledingii* Peebles
50–55 μ—*E. polyacanthus* Engelm.
50–67 μ, mostly 50–60 μ—*E. pentalophus* (D. C.) Rumpler
52–54 μ—*E. Engelmannii* (Parry) Rumpler
57–59 μ—*E. coccineus* Engelm.
61–62 μ—*E. Bonkerae* Thornber & Bonker
62 μ—*E. rectispinus* Peebles
63–64 μ—*E. Fendleri* (Engelm.) Rumpler
64–65 μ—*E. rigidissimus* (Engelm.) Rose
64–70 μ—*E. rectispinus* var. *robustus* Peebles
65–69 μ—*E. Boyce-Thomsonii* Orcutt.

OPUNTIA

Grain dodecacolpate; cube and dodecahedron; 65–130 μ in diameter; exine thick, pitted or reticulate; exine thrown into ridges or ridges not

present; furrows coincide with germ pores; pores flat to convex, smooth, granular or flecked, circular to linear. Usually *Opuntia* grains are cube and dodecahedrons, with a germinal furrow (germ pore) in the center of each of twelve more or less regular hexagons, and six thick, highly reticulate or pitted tetragons (fig. 1). Assuming any two opposite tetragons as poles, three equal polar axes are formed, and the grain appears the same when viewed parallel to each of the three axes. Most samples of pollen of *Opuntia* contain grains of the cube and dodecahedron type, and from few to many grains have more numerous faces (about 30 in *O. gilvescens*), which may be tetragons, triangles, pentagons, hexagons, or in *O. flavescens* regular grains having eight heptagons, six tetragons, and eight hexagons occur (fig. 2). Grains with more than eighteen faces are usually polycolpate with more than the regular number of twelve furrows. The exine in most species is thick except over the hexagons and pores. The ridges are high to low, narrow to wide, depending upon the species. The exine of the tetragons may be pitted or from finely to coarsely reticulate, and the ridges sculptured similarly. The degree of reticulation or pitting is the most consistent character of each species (figs. 4–9). The sculpturing usually becomes granular in the hexagons up to or over the germ pores. If the germ pores are convex in the expanded form they often break through the exine, causing an irregular pore margin. The pores and hexagons evidently act as harmomegathy for the expansion of the grain because in the dry form the hexagons appear as if pushed in, the whole grain assuming a very wrinkled or crumpled form. Upon expansion of the grain the pores may become very prominently protruding or convex, which is especially distinct in *O. fragilis* (fig. 9). It is interesting to note that all grains that possess pitted exine are from plants that belong to the subgenus *Cylindropuntia* or "chollas," whereas all grains that have reticulate exine are from plants of the subgenus *Platyopuntia* or "prickly pears." Comparisons of species in these two groups are as follows.

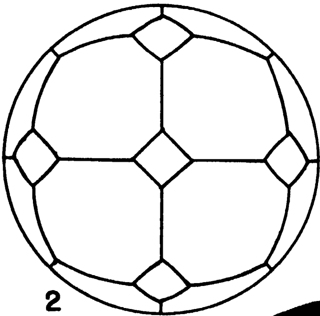
Opuntia subg. *Cylindropuntia*

A. Germ-pores convex (fig. 4)

65–68 μ; pores flecked.	*Opuntia leptocaulis* DC.
73–90 μ, mostly 78–82 μ; pores flecked, flat or mostly convex.	*O. fulgida* Engelm.
76–86 μ; pores flecked.	*O. acanthocarpa* var. *ramosa* Peebles
82–90 μ; pores flecked.	*O. Whipplei* Engelm. & Bigel.
80–120 μ; mostly 98 μ; many irregular.	*O. Bigelovii* Engelm.
93–94 μ; pores flat or convex, granular.	*O. versicolor* Engelm.
98–100 μ; pores granular, flat or convex.	*O. echinocarpa* Engelm. & Bigel.
107 μ; pores flecked, margins irregular.	*O. acanthocarpa* Engelm. & Bigel.

AA. Germ-pores flat, not convex (fig. 5)

73–90 μ, mostly 78–82 μ; pores flecked, flat or mostly convex.	*O. fulgida* Engelm.
73–100 μ, mostly 73–81 μ; pores flecked.	*O. tetracantha* Toumey



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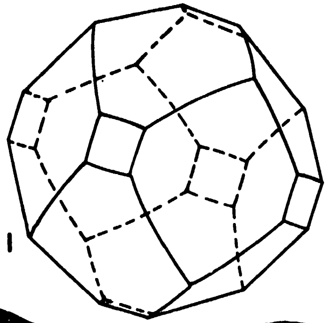

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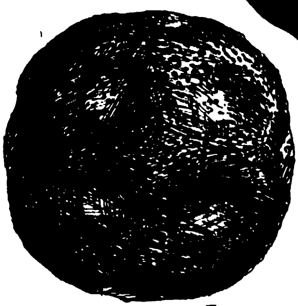

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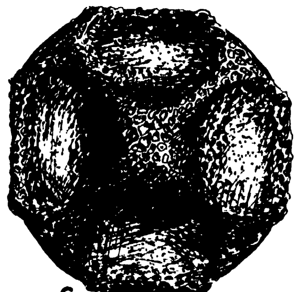

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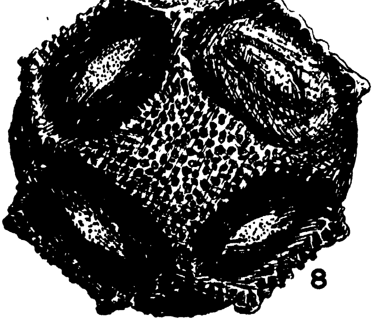

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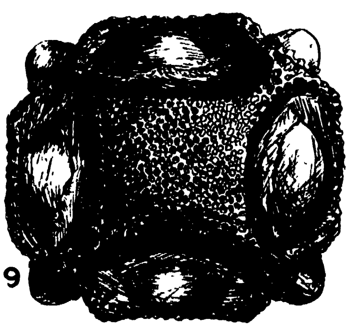

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78–82 μ; pores flecked. *O. fulgida* var. *mamillata* (Schott) Coulter
86–94 μ, mostly 90 μ; pores granular. *O. spinosior* (Engelm.) Toumey
90 μ; pores granular. *O. Stanlyi* var. *Kunzei* Rose
90 μ; pores granular. *O. Kunzei* Rose
90–93 μ; pores pitted or granular. *O. Wrightiana* (Baxter) Peebles
93–94 μ; pores granular. *O. versicolor* Engelm.
98–100 μ; pores granular. *O. echinocarpa* Engelm. & Bigel.
100–106 μ; pores granular. *O. Thornberi* Thornber & Bonker

Opuntia subg. *Platyopuntia*
B. Exine coarsely reticulate
(figs. 6, 7)

94–100 μ; ridges prominent; pores not distinct, convex, may be flecked; tetragons 40–45 μ wide. *O. basilaris* Engelm. & Bigel.
96–100 μ; many irregular; ridges distinct; pores circular, granular. *O. Santa-Rita* (Griffiths & Hare) Rose
98–106 μ; coarsely to medium reticulate; usually regular; ridges distinct, not high; pores linear, reticulate or granular, flat or convex. *O. macrocentra* Engelm.
97–122 μ, mostly 105–110 μ; many irregular; exine finely to coarsely reticulate; ridges distinct; pores circular to linear, convex, flecked; tetragons 48–50 μ wide. *O. Loomisii* Peebles
106–114 μ; mostly irregular; ridges distinct; pores linear, convex, flecked. *O. tenuispina* Engelm.
106–119 μ, mostly 109–114 μ; irregular, some with ridge scheme of heptagons; ridges distinct, narrow; exine finely to coarsely reticulate; pores circular to linear, granular, flat. *O. flavescens* Peebles
110–114 μ; mostly irregular; ridges distinct; pores circular, distinct, convex, granular; tetragons 20 μ wide. *O. laevis* var. *canada* (Griffiths) Peebles
106–130 μ, mostly 114 μ; mostly irregular; exine finely to coarsely reticulate; ridges distinct; pores indistinct, circular to linear, flat to convex, granular. *O. phaeacantha* Engelm.
115–125 μ; mostly irregular; ridges distinct; pores circular, slightly convex, granular. *O. Engelmannii* Salm-Dyck
130 μ; mostly irregular with up to 30 faces; exine finely to coarsely reticulate; ridges distinct; pores indistinct, slightly convex, granular. *O. gilvescens* Griffiths

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Explanation of figures 1–9

FIG. 1. Regular cube and dodecahedron characteristic of *Opuntia pollen.* FIG. 2. Regular atypical ridge scheme of *Opuntia flavescens*, polar view, four of the eight heptagons are visible. FIG. 3. Pollen grain of *Echinocactus acanthodes*, polar view, 52 μ in diameter, exine finely pitted, typical of the pollen of *Cereus, Echinocactus, Mammillaria,* and *Echinocereus*. FIG. 4. Pollen grain of *Opuntia acanthocarpa*, 107 μ in diameter, exine pitted, typical of pollen of subg. *Cylindropuntia* with convex pores. FIG. 5. Pollen grain of *Opuntia fulgida* var. *mamillata*, 80 μ in diameter, exine pitted, typical of pollen of subg. *Cylindropuntia* with flat pores. FIG. 6. Pollen grain of *Opuntia macrocentra*, 98 μ in diameter, exine coarsely reticulate, typical of pollen of subg. *Platyopuntia*. FIG. 7. Pollen grain of *Opuntia basilaris*, 97 μ in diameter, exine coarsely reticulate, pores convex, typical of pollen of subg. *Platyopuntia*. FIG. 8. Pollen grain of *Opuntia ursina*, 100 μ in diameter, exine finely reticulate, pores slightly convex, typical of the pollen of the subgenus *Platyopuntia*. FIG. 9. Pollen grain of *Opuntia fragilis*, 90 μ in diameter, exine finely reticulate, pores very convex.

BB. Exine finely reticulate
(figs. 8, 9)

89–98 μ, mostly 90 μ; ridges distinct; tetragons 32–38 μ wide; pores linear, may be very convex. *O. fragilis* (Nutt.) Haworth.

90–114 μ; some irregular; ridges distinct; pores linear, convex, granular. *O. rhodantha* Schuman

91–113 μ, mostly 98–101 μ; ridges distinct; tetragons 41–48 μ; pores linear, convex, granular. *O. hystricina* Engelm. & Bigel.

81–98 μ, mostly 95–98 μ; some irregular; ridges distinct; tetragons 38–40 μ; pores distinct, circular, convex, granular. *O. polyacantha* var. *trichophora* (Engelm. & Bigel.) Coulter

97–110 μ, mostly 108 μ; many irregular; ridges distinct; pores indistinct, convex, granular, circular. *O. aurea* Baxter

98–102 μ; ridges distinct; tetragons 40 μ; pores linear, convex, flecked. *O. ursina* Weber

98–106 μ, mostly 98–101 μ; some irregular; ridges narrow, distinct; pores linear, convex, granular. *O. erinacea* Engelm.

98–108 μ; exine thick; ridges distinct; pores linear, about 65 μ long, slightly convex, granular. *O. hystricina* var. *rhodantha* Schuman

97–122 μ, mostly 105–110 μ; some irregular; tetragons 48–50 μ wide; exine finely to coarsely reticulate; pores circular to linear, convex, flecked. *O. Loomisii* Peebles

106–122 μ, mostly 109–114 μ; ridges distinct; tetragons 46 μ wide; pores distinct, circular, convex, flecked. *O. polyacantha* Haworth.

106–119 μ, mostly 109–114 μ; mostly irregular with ridge scheme of heptagons; ridges distinct, narrow; exine finely to coarsely reticulate; pores circular to linear, flat, granular. *O. flavecens* Peebles

111–117 μ, mostly 114 μ; mostly irregular; ridges high, 11 μ wide; tetragons 40 μ wide; pores granular or reticulate, circular. *O. tortispina* Engelm. & Bigel.

106–130 μ, mostly 114 μ; mostly irregular; exine finely to coarsely reticulate; ridges distinct; pores indistinct, circular to linear, flat to convex, granular. *O. phaeacantha* Engelm.

130 μ; mostly irregular with up to 30 faces; exine finely to coarsely reticulate; ridges distinct; pores indistinct, slightly convex, granular. *O. gilvescens* Griffiths

SUMMARY

1. A study was made of the pollen of 75 species and varieties of the Cactaceae, mostly native to Arizona.

2. The pollen of species of *Cereus*, *Echinocereus*, *Echinocactus*, and *Mammillaria* are usually tricolpate with a finely pitted exine. The diameter range of pollen of these genera is from 41 to 82 μ.

3. Species of *Opuntia* exhibit regular and irregular pollen. Regular grains are cube and dodecahedrons with twelve germ pores (germinal furrows), and the exine is either pitted (subg. *Cylindropuntia*), or from finely to coarsely reticulate (subg. *Platyopuntia*). Irregular grains have more than eighteen faces, and usually a correspondingly increased number of germ pores. Pollen grains of *Opuntia flavescens* are either typical cube and dodecahedrons or regular atypical grains with eight heptagons, six tetra-

gons, and eight hexagons. The diameter range of *Opuntia* pollen is from 65 to 130 μ.

4. Pollen of *Echinocereus pentalophus* is either tricolpate, or large and dodecacolpate, this form closely resembling the smaller pollens of *Opuntia*.

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BULLETIN OF THE TORREY BOTANICAL CLUB
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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—V

BASSETT MAGUIRE AND COLLABORATORS

HUMIRIACEAE[95]

Page references are given to R. C. Bakhuizen v./d. Brink fil., Humiriaceae, Flora of Suriname **3**: 412–421. 1941.

HUMIRIA BALSAMIFERA (Aubl.) St. Hil. (414). SURINAM: tree, vicinity Arawak village of Mata, *24957*. Guiana, Venezuela, Rio Negro. Throughout the country.

HUMIRIA CRASSIFOLIA Mart. BRITISH GUIANA: occasional, 6 m. tree, 12 cm. diam., leaves rigid, coriaceous, young fruits oval, green, seed bony, pale brown, from bush island, Kaieteur Savanna *23233*. New to British Guiana; described from the Serra de Arara Coara, Japura River, near the Peru frontier. The specimen quite agrees with Martius's excellent figure (Nova genera et species **2**: pl. 198. 1826. I have seen no other record; the species is not mentioned by Ducke in his survey of the Amazonian species in Arch. Inst. Biol. Veg. Rio de Janeiro **4**: 25. 1938.

HUMIRIA FLORIBUNDA Mart. (416). SURINAM: shrub to 4 m., much branched, rounded, flowers white, savanna vicinity of Savanna I, Tafelberg, *24223;* frequent, shrub or bushy small tree to 8 m., 10 cm. diam., flowers white, extensive rock and pigmy bush openings, Savanna VIII, Tafelberg, *24443;* frequent, shrub to much branched rounded tree of 7 m. height, Savanna II, *24707;* common, shrub or rounded much branched tree to 10 m. high, 25 cm. diam., Savanna VII, Tafelberg, *24789*. Guiana, Brazil.

HUMIRIA FLORIBUNDA Mart. var. GUIANENSIS (Benth.) Urb. BRITISH GUIANA: frequent, bushy-crowned tree 4–6 m. high, 4–8 cm. diam., flowers greenish-white from bush island, Kaieteur Savanna, *23295;* occasional, shrubby, procumbent, 1 m. high clump, 2–3 m. diam., flowers white, buds light green, Kaieteur Savanna, *23450*. SURINAM: shrub to 3 m. high, flowers greenish-white, grass savanna, Zanderij II, *23654; 23696*. Guiana. Rio Branco. Throughout the country, more common than the preceding form.

SACOGLOTTIS GUIANENSIS Benth. (418). SURINAM: frequent, tree 15 m. high, 20 cm. diam., flowers greenish, fragrant, wallaba forest, km. 19, line between Camps No. 5 and 4, Coppenam River Headwaters, *24836;* frequent, tree 20 m. high, 30 cm. diam., flowers greenish, fragrant, high mixed wallaba forest, base talus, Tafelberg, *24844*. Guiana, Brazil. The specimens probably belong to the var. *dolichocarpa* Ducke, but are without fruits.

MALPIGHIACEAE[96]

Page references are given to: A. J. G. H. Kostermans, Malpighiaceae, Flora of Suriname **2**: 146–243. 1936.

[95] By G J. H. Amshoff.
[96] G. J. H. Amshoff.

HIRAEA FAGIFOLIA (DC.) Juss. var. BLANCHETIANA (Moric.) Ndz. (168). SURINAM: infrequent, liana to 30 m., flowers pink-lavender, Charlesburg Rift, open shrub land, *22777*. Northern South America to Guatemala. Probably throughout the country; common in the Pará district.

HIRAEA CHRYSOPHYLLA Juss. (169). SURINAM: frequent, vine along river, flowers yellow, low bush bordered by *Montrichardia arborescens*, lower Saramacca River, vicinity Tawa Creek, *23744;* frequent vine, flowers yellow, bush to rear of village of Jacob kondre, Saramacca River, *23864;* frequent, vine, flowers yellow, stamens white, riverbanks Toekoemoetoe Creek, *24065*. Northern Brazil, Guiana. Common throughout the country.

TETRAPTERIS SQUARROSA Griseb. BRITISH GUIANA: rare, shrub 1.6 m. high, strict growth, paired glands green leaves chartaceous, from river fringe, Kaieteur Plateau, *23248;* occasional, rope from crown of small tree, petals yellow, clawed, anthers orange, paired glands green, along river, Kaieteur plateau, *23302*. SURINAM: frequent, scandent shrub, flowers yellow, rocks, Grasifalls, Saramacca River, *24946*. Northern South America as far as Peru. Throughout Surinam.

TETRAPTERIS FIMBRIPETALA Juss. (177). SURINAM: infrequent, shrub to 1 m., savanna, Zanderij I, *23716;* infrequent, vine, opening in *Clusia* bush, along escarpment, Tafelberg, *24630*. Guiana. Probably throughout Surinam but apparently not common.

TETRAPTERIS ACUTIFOLIA Cav. (179). SURINAM: liana, above Posoegronoe, Saramacca River, *24038*. Brazil to Guiana; in Surinam known but from few collections.

HETEROPTERIS MACROSTACHYA Juss. (192). SURINAM: liana, leaves silvery-tan beneath, flowers yellow, above Posoegronoe, Saramacca River, *24036;* liana, leaves deep green above, silvery-buff beneath, veins dark brown, ovules 1, pericarp scantily scurfy within, fruits scurfy brown, 5–10 km. above Boschland, Saramacca River, *24041; 24048*. From Costa Rica to Peru, West Indies. Throughout the country.

HETEROPTERIS MULTIFLORA (DC.) Hochr. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River, *F3607*. Northern South America, Jamaica.

HETEROPTERIS NERVOSA Juss. (193). SURINAM: frequent, vine, flowers yellow, along Saramacca River, vicinity Brokolonka, *23788*. Northern South America from Panama to Peru; West Indies. Common throughout the country.

BANISTERIOPSIS LUCIDA (Rich.) Small. BRITISH GUIANA: frequent, rope with drooping shoots, fruit a samara, seed yellow-green, wing pink, along Potaro River above Kaieteur Fall, *23354*. Brazil, Guiana, West Indies.

BANISTERIOPSIS LEPTOCARPA (Benth.) R. O. Williams. BRITISH GUIANA: 4 cm. diam. black, soft, pliable rope used for cordage, from crown of a *Tapitira* in *Manicaria* swamp forest, leaves thinly leathery, glabrous, flowers in large terminal inflorescences on side shoots, the individual branchlets subtended by leafy bracts, calyx green, petals yellow, crinkled, clawed, *F5136*. SURINAM: frequent, rope in forest top, flowers yellow, dakama forest, bottom of Arrowhead Basin, Tafelberg, *24615;* vine, flowers yellow, opening in *Clusia* bush along escarpment, Tafelberg, *24632*. Guiana, Trinidad. In Surinam hitherto known but from two collections of the Weyne road.

BANISTERIOPSIS ELEGANS (Tr. et Pl.) Sandw. subsp. CORDATA (Ndz.) Sandw. var. PULCHERRIMA Sandw. BRITISH GUIANA: frequent vine twining over low trees, flowers yellow, glands green, Kaieteur Savanna, *23125*. Endemic.

STIGMATOPHYLLON CONVOLVULIFOLIUM (Cav.) Juss. (206). SURINAM: frequent, flowers yellow, along railroad near km. 70, *23604;* frequent, vine, petals orange-red, with yellow center, very showy, bush to rear of village Jacob kondre, Saramacca River, *23847;* vine, flowers yellow, buds orange-red, outer petal orange, red beneath, wallaba forest, vicinity Base Camp, Tafelberg Creek, *24110*. Northern Brazil, Guiana, Venezuela, West Indies. Throughout the country.

STIGMATOPHYLLON FULGENS (Lam.) Juss. (208). SURINAM: flowers yellow, saramas red, vicinity Sectie O, km. 68, *25000*. Northern Brazil, Guiana, Venezuela, West Indies. Throughout the country.

BRACHYPTERYS OVATA (Rich.) Small. (211). BRITISH GUIANA: vine, leaves herbaceous, flowers in short axillary fascicles, subtended by rounded leafy bracts, calyx green, paired glands brownish-green, petals ligulate, yellow, stamens green, stigmas green, inverted, boot-shaped, young fruit of 3 carpels, shaped like segments of an oval, Hacket Ck., R. B. lower Waini River N.W.D., *F5059*. SURINAM: low shrub, flowers yellow, open areas, coastal jungle, road to Carol Francois along Saramacca River, km. 79 from Paramaribo, *23598*. Coastal vegetation of South America and the West Indies; common in Surinam.

SPACHEA ELEGANS (G. F. W. Meyer) Juss. (213). SURINAM: infrequent, tree 12 m. tall, 15 cm. diam., leaves firm, glossy, pedicels pink, flowers subtended by 8 thick white glands, petals pink, white tipped, anthers yellow, below rapids, riverbanks, vic. Jacob kondre, Saramacca River *23814*. Guiana, Amazonian district, Trinidad, St. Vincent. Probably throughout the country.

The Byrsonimas of British Guiana have been treated by Sandwith in Kew Bulletin **1935** and in Journ. Arn. Arb. **24** (1943).

BYRSONIMA CRASSIFOLIA (L.) Rich. ex Juss. (226). BRITISH GUIANA: occasional, tree 5 m. high, 6 cm. diam., flowers yellow, inflorescence and young leaves rusty-tomentose, fruit yellow, from bush island, Kaieteur Savanna, *23260*. SURINAM: shrub to 3 m., flowers yellow, grass savanna, Zanderij II, *23697;* open bush, north escarpment, Tafelberg, *24328a;* infrequent, shrub to 3 m., flowers yellow, Savanna IV, Tafelberg, *24378;* frequent, shrub to 2 m., flowers yellow, Savanna VIII, Tafelberg, *24573;* frequent, shrub to 4 m. high, 5 cm. diam., flowers yellow, fruits without wings, Savanna II, Tafelberg, *24705;* flowers yellow, south savanna, vicinity Arawak village of Mata, *24964;* tree 8 m. high, 12 cm. diam., flowers yellow, savanna vicinity Sectie O, km. 68, *25021*. Central America, West Indies; Northern South America. Probably throughout the country.

BYRSONIMA CORIACEA (Sw.) Kunth (229). SURINAM: tree, 25 m. high, 35 cm. diam., inner bark thick, red, flowers yellow, hill no. 1 between North Ridge and Augustus creek, Tafelberg, *24724*. Tropical South America; West Indies. Probably throughout the country.

BYRSONIMA AERUGO Sagot (231). SURINAM: large tree, 25 m. tall, 40 cm. diam., flowers yellow, swampy bush to rear of Kwatta hede, *23921*. Guiana. In Surinam hitherto only collected in the forest reserves Brownsberg and Zanderij I.

BYRSONIMA GYMNOCALYCINA Juss. SURINAM: tree 20 m. tall, 10 cm. diam., glands pink in bud, opening in *Clusia* bush, between Savanna VIII and S. W. escarpment, Tafelberg, *24623*. New to Surinam, hitherto only known from British Guiana. The nearly allied *B. obversa* Miq. (241), known from Surinam, French Guiana and Pará, but apparently not extending to British Guiana, has been collected in several localities between the Marowijne River and the lower Coppenam River.

BYRSONIMA EUGENIIFOLIA Sandw. BRITISH GUIANA: occasional, tree 6 m. tall, 15 cm. diam., leaves leathery, calyx lobes and inflorescence crimson, fruit greenish, flushed crimson, paired glands grey on back, bush island, Kaieteur Savanna II, *23144* Endemic.

BYRSONIMA INCARNATA Sandw. BRITISH GUIANA: occasional, 16 m. tree, 30 cm. diam., fruit orange-yellow, fleshy, slightly astringent, edible, *Dicymbe* forest, Potaro River Gorge, *23535*. Endemic; third collection known.

VIOLACEAE

AMPHIRRHOX SURINAMENSIS (Miq.) Eichl. BRITISH GUIANA: tree to 12 feet high, flowers asymmetrical, anthers long-awned, mixed forest, Takutu Creek, Puruni River, Mazaruni River, *F2072* (*F.D. 4808*); tree 30 feet high, 4 inches diam., fruit trigonal-ovoid, young, greenish, flushed red, glossy, Takutu Creek, Puruni River, Mazaruni River, *F2151* (*F.D. 4887*); shrub to 12 feet high, secondary forest, Mabaruma, Aruka River, N. W. D. *F2427* (*F.D. 5163*).

CORYNOSTYLIS ARBOREA (L.) Blake. SURINAM: vine with milky sap, flowers long-spurred, white, frequent, bush to rear of Jacob kondre, Saramacca River, *23845*; vine, flowers white, fragrant, km. 5, Tafelberg Creek, Saramacca River Headwaters, *24892*. Variable and widespread, Mexico, West Indies to Peru and the Amazon Basin.

No. *24892*, because of its very thin, elliptic-obovate leaves with more numerous veins and longer, slender petioles, and solitary axillary flowers with the terminal in a simple raceme, seems hardly referable to *C. arborea* as it is represented in the herbarium of the New York Botanical Garden; yet in view of the polymorphy and lack of critical study of that species, it would be well to hold in abeyance any other disposition of the Tafelberg Creek collection.

PAYPAYROLA GRANDIFLORA Tul. BRITISH GUIANA: tree 20 feet high, 4 inches diam., Mahdia Creek, Potaro River, 108 mile, Bartica-Potaro Road, *F761* (*F.D. 3497*); shrub or small tree from Kakaralli clump, wallaba forest, 107 mile, Bartica-Potaro Road, *F1459* (*F.D. 4195*). Upper Amazon Basin, Brazil and Peru; new to British Guiana.

PAYPAYROLA LONGIFOLIA Tul. BRITISH GUIANA: small tree 10 m. high, 16 cm. diam., mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22828*. British Guiana.

PAYPAYROLA GUIANENSIS Aubl. SURINAM: small tree 4 m. high, flowers yellow, Campo Dungeoman, Saramacca River, 6 km. below mouth Toekoemoetoe Creek, *24058*. Surinam, French Guiana, Pará, Brazil.

RINOREA FLAVESCENS (Aubl.) Kuntze. BRITISH GUIANA: undergrowth tree to 30 feet high and 4 inches diam., mixed forest, Makauria Creek, Essequibo River, *F520* (*F.D. 3256*). Guiana; Amazon Basin, Brazil and Peru.

RINOREA MACROCARPA (Mart.) Kuntze. SURINAM: shrub or small tree

4 m. high, flowers white, montane forest, Kwatta Camp (no. 3) Coppenam River Headwaters, *24150*. Surinam; Amazon Basin, Brazil and Peru.

RINOREA PUBIFLORA (Benth.) Sprague and Sandw. BRITISH GUIANA: shrub of Mora forest, Barima River opposite Anabisi Creek, *F2463* (*F.D. 5199*); small tree 3–4 m. high, 4–5 cm. diam., occasional, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22942*. SURINAM: shrub or small tree to 5 m. high, flowers white, border pina swamp, vicinity Krappa Camp (no. 2), Saramacca River Headwaters, *24122*. Guiana, Colombia, Brazil and Peru.

RINOREA RIANA (DC) Kuntze. BRITISH GUIANA: small undergrowth shrub with brown, pubescent, trigonal fruit, Siba Creek, Essequibo River, *F775* (*F.D. 3511*); small tree or shrub to 2 m. high, flowers white, fruit green, hairy, Kamuni Creek, Groete Creek, Essequibo River, March 27, 1944, *Fanshawe s.n.*, Colombia, Venezuela, Trinidad, Guiana.

RINOREA cf. C. FLAVESCENS (Aubl.) Kuntze. SURINAM: small tree overhanging Tafelberg Creek, vicinity Base Camp, *24894*, fruiting material only. Not matched at the New York Botanical Garden. Apparently closely related to *C. flavescens*, but hardly that species.

TURNERACEAE

TURNERA GLAZIOVII Urb. SURINAM: shrub or small tree, flowers yellow, frequent in low bush, vicinity Savanna III, Tafelberg, *24270; 24270a; 24271*. Our specimens conform reasonably well to the original description[97] based on *Glaziou 9852* and *9857* (Kew) from "Brasilia septentrionali;" and to a photograph of *Glaziou 9852* made at Berlin. No authentic specimens of *T. Glaziovii* have been seen.

BEGONIACEAE[98]

BEGONIA GLABRA Aubl. SURINAM: frequent, climbing to 30 feet, high forest, base of south cliffs, Arrowhead Basin, 625 meters altitude, Tafelberg, *24477*. Southern Mexico and the West Indies to Guiana, Bolivia and Peru.

BEGONIA JENMANI Tutin. BRITISH GUIANA: frequent, rocky ground, trail Tukeit to Kaieteur, Potaro River Gorge, *23081;* moist rocks, Potaro River Gorge, *23530*. Known only from the type region.

BEGONIA PRIEUREI A. DC. BRITISH GUIANA: weed beneath rest house, Kaieteur Falls, *23470*. SURINAM: common, wet moss-covered walls and damp soil, base of north escarpment, Tafelberg, *24329;* locally frequent, high mixed forest, vicinity of Augustus Falls, base of north escarpment, Tafelberg, *24760*.

LECYTHIDACEAE

COURATARI MULTIFLORA (Smith) Eyma. BRITISH GUIANA: tree 6 m. high, 10 cm. diam., fruit green before opening, afterwards brown, seed winged, frequent, riverside, Potaro River Gorge, below Amatuk Portage, *23555;* tree 12 m. high, 20 cm. diam., Potaro River Gorge, below Tukeit, *23501*. Apparently confined to British Guiana.

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97 Monog. Turneraceae, 1883.

98 By Lyman B. Smith and Bernice G. Schubert.

ESCHWEILERA CORRUGATA (Poit.) Meirs. SURINAM: small tree overhanging Tafelberg Creek, 5 km. below Base Camp, *24902*; tree 12 m. high, 20 cm. diam., Kwatta hede, Saramacca River, *23943*. Generally distributed in Guiana.

While *23943* is probably properly referred to this species, its leaves are almost imperceptably reticulate, not conspicuously so as in all other specimens of the species that I have seen, and its pedicels are not at all warty, the conspicuous character that gives rise to the name *E. corrugata*. It is suspected that our collection may represent a distinct variety.

ESCHWEILERA HOLCOGYNE Sandw. BRITISH GUIANA: tree exceeding 100 feet high, 4 feet diam., non-buttressed, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22916*. British Guiana; little collected.

The original description[99] was made with fruit unavailable. The postmature pyxidia of the above collection are broadly obovate 6–7 cm. long, 5–7 cm. broad, usually somewhat asymmetrical, the bases truncate, the opercula disciform, 4–5 cm. in diam., and the sepal scars prominent. The seeds are 3–3.5 cm. long, about 2 cm. wide, elliptic-oblong, the outer face convex, the inner single or two faces plane, the testa brown, deeply sculptured.

ESCHWEILERA LABRICULATA Eyme. SURINAM: small tree 4 m. high, 6 cm. diam., flowers pink, anthers white, androecial hood flat, basally bearing fertile anthers, frequent, swampy bush to the rear of Kwatta hede, Saramacca River, *23911*. Sparingly known from Surinam only.

ESCHWEILERA LONGIPES (Poit.) Miers. SURINAM: small tree 10 m. high, 15 cm. diam., flowers totally deep pink, Tafelberg Creek, 8 km. below Base Camp, *24075*; Tafelberg Creek *24907*. Generally distributed in Guiana.

GUSTAVIA ANGUSTA Alm. BRITISH GUIANA: tree 10 m. high, 10 cm. diam., flowers white, Mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22888*. SURINAM: frequent, riverbanks, Saramacca River above Kwatta hede, *23930*. Highly variable and widely distributed in northern South America.

MYRTACEAE[100]

The present report on the Myrtaceae collected by Maguire and by Maguire and Fanshawe in Surinam and British Guiana is at the same time a second paper preliminary to my account of the Myrtaceae in the Flora of Surinam. I have referred to this as yet unpublished account by citing the number of the genera and the species. The first preliminary paper appeared in 1942 as no. 86 of the "Mededelingen van het Botanisch Museum en Herbarium van de Rijksuniversiteit te Utrecht." The remaining new and critical species will be dealt with in a third preliminary paper.

CALYPTRANTHES FASCICULATA Berg (I 2). BRITISH GUIANA: shrub or small tree to 15′ with many shoots, leaves chartaceous, rufous-tomentose beneath, fruits clustered in axils, stalked, globose, dull purplish, covered with rufous or grey indumentum, seed one, Takutu Creek to Puruni River, Mazaruni River, *F.D. 4758*; *4759*. Trinidad, Venezuela, Br. Guiana, Surinam.

CALYPTRANTHES LUCIDA Mart. ex DC. (I 4). SURINAM: tree to 15 m. high, 18 cm. diam., wood white, hard, flowers white, mixed high forest, base

[99] Kew Bull. 1935: 126.

[100] By G. J. H. Amshoff.

north escarpment, Tafelberg, *24300;* frequent, tree to 20 m. high, 30 cm. in diameter, flowers whitish, opening by Grace Falls, Arrowhead Basin, Tafelberg, *24491;* frequent, tree to 10 m. high, 15 cm. in diam., flowers white, overhanging stream, high forest East Ridge Gorge, Tafelberg, *24542;* frequent, tree 18 m. high, 25 cm. diam., flowers white, immature fruit red, mixed high forest, base of cliffs, west escarpment, Tafelberg, *24691;* tree 15 m. high, 20 cm. diam., immature fruit red, mixed high forest, base of cliffs, west escarpment, Tafelberg *24692.* Southern and central Brazil (Berg), not otherwise collected in Guiana, but probably still more widely distributed. Unfortunately, I could not compare the type, but the specimens agree well with Berg's detailed description and with a photo of the type.

CALYPTRANTHES cf. C. PULCHELLA DC. (I 6). SURINAM: common, small tree 12 m. high, 8 cm. diam., flowers white, diabasic soil, mixed high forest, Hill No. I, Tafelberg, *24714* fl. Sept.; small tree to 8 m. high, 4 cm diam., flowers whitish, low bush, Savanna No. II, Tafelberg, *24267.* Mr. R. Weibel of the Geneva herbarium has been so kind as to compare a fragment of Maguire *24714* with the type of *C. pulchella* DC. He writes that the type specimen is unfortunately imperfect and does not allow a certain identification. The glandular dots on the undersurface of the leaves of *Maguire 27714* are less abundant than in the type, the flower buds more pointed and more densely pubescent. Yet, as Berg in Mart. Fl. Bras. XIV 1 p. 14 has already described two varieties, it is possible that the Tafelberg specimens too fall within the variability of the species.

Marlierea salticola Amsh. sp. nov. Frutex ramosissimus ramulis subteretibus cito glabratis. Folia anguste oblonga vel oblanceolata, basi acuta, apice obtusa, novella sparse pilosa pilis dibranchiatis, adulta glabra, dense ± elevato-punctata, coriacea, usque ad 7 cm. longa 2 cm. lata, costa supra leviter impressa subtus valde prominenti nervis lateralibus numerosis tenuibus utrinque prominulis nervo marginali vix 1 mm. a margine distanti, petiolo circ. 3 mm. longo. Inflorescentiae pauciflorae circ. 5-florae subglabrae folio breviores ± 2 cm. longae bractea lineari ± 8 mm. longa suffultae. Alabastra clausa, ± fusiformia, obtusa, — 5 mm. longa basi sparse pilosa ceterumque glabra. Petala nulla? Ovarium 2-loculare 4-ovulatum ovulis ascendentibus. Fructus globosus margine libero receptaculi et calyce lacerato coronatus monospermus in sicco – 8 mm. in diametro, cotyledonibus contorto-plicatis, radicula elongata, geniculata.

TYPE: locally common, erect shrub to 3 m., flowers white, Amatuk Portage, Potaro River Gorge, British Guiana, May 19, 1944, *Maguire & Fanshawe 23549.* Kangaruma, Potaro R., on rocks in falls, *Abraham 377* fr. Oct. 1922(K). Probably allied to *M. montana* (Aubl.) Amsh., but quite distinct by the form and indumentum of its flower buds and by its narrow leaves. The species is possibly, as are so many *Psidium* species, restricted to the river bed.

MARLIEREA SCHOMBURGKIANA Berg (II 1). BRITISH GUIANA: frequent, tree 15 m. high, 15–30 cm. diam., fruit blue, edible, sweet, mixed woodland, Kamuni Creek, Groete Creek, Essequibo River, *22911.* Frequent throughout British Guiana, once collected in Surinam.

Marlierea buxifolia Amsh. sp. nov. Arbor parva vel frutex ramosissimus ramulis novellis villosis. Folia obovato-oblonga, apice obtusa vel ro-

tundata basi acuta, novella utrinque pubescentia adulta supra glabra subtus pubescentia, coriacea, margine revoluta, circ. 4 cm. longa 2 cm. lata, costa supra impressa subtus valde prominenti, nervis venisque obsoletis. Petiolus circ. 3 mm. longus. Inflorescentiae in axillis foliorum superiorum saepe bracteiformium, albido-villosae, 2–3 cm. longe pedunculatae, 3- vel 5-florae; floribus sessilibus, terminalibus ternis 2 inferioribus saepe additis, bracteis subulatis alabastra aequantibus. Alabastra villosa apice acuminata clausa. Calyx in flore aperto irregulariter laceratus. Petala orbicularia circ. 2 mm. longa. Ovarium 2-loculare 4-ovulatum. Fructus immaturus subglobosus, maturus ignotus.

TYPE: Kaieteur savanna, thicket on rocky ground, *Sandwith 1340* fl. Sept., low tree, leaves coriaceous, box-like, very dark green above, greyish-glaucous beneath, petals and filaments white (U, K). Cotype: Kaieteur savanna, bush island, *Maguire and Fanshawe 23272* defl.; shrub 1–2 m. high, leaves narrow, oblong, margin revolute, inflorescence woolly, fawn-colored. Kaieteur savanna, *Jenman 1245* fl. Sept./Oct. 1881; 3–4 feet high (K). A very distinct species, well characterized by its few-flowered inflorescences and by its indumentum.

MARLIEREA MONTANA (Aubl.) Amsh. (II 2). SURINAM: frequent, shrub to 1.5 m. high, flowers white, wet sand, savanna, Zanderij I, *23715* fl. June; shrub about 5 m. high, savanna vicinity Sectie O, km. 68, *25015;* shrub or tree to 8 m. high, fruit edible, south savanna, Arawak village of Mata, *24986;* frequent, shrub or small tree up to 10 m. high, Tafelberg, *24444, 24643, 24656, 24790, 26173.* Guiana. Frequent in Surinam and British Guiana, rarely collected in French Guiana. (*Aublet s.n.* [B M], type of *Eugenia montana* Aubl., herb. Richard [P], type of *M. Richardiana* Berg).

Marlierea cuprea Amsh. sp. nov. Arbor parva ramulis gracilibus novellis compressis sericeis. Folia elliptico- vel obovato-oblonga, basi acuta, apice abrupte acuminata, tenuiter coriacea, subnitida, supra glabra, subtus sericea, glabrescentia, 6–10 cm. longa 3–4 cm. lata, obscure pellucido-punctata, costa supra impressa subtus prominenti, nervis lateralibus tenuissimis supra fere obsoletis subtus vix prominulis nervo marginali circ. 1 mm. a margine remoto, venis obsoletis. Petiolus canaliculatus demum transverse rugosus – 5 mm. longus. Inflorescentiae axillares paniculatae cupreo-sericeae foliis aequantes vel longiores multiflorae, bracteis parvis acutis deciduis, floribus subsessilibus. Alabastra obovoidea apice breviter 4-loba extus sericea – 3 mm. longa. Receptaculum supra ovarium valde productum demum ad verticem ruptum. Sepala brevissima, semilunaria, utroque latere sericea. Petala 4, vix 2 mm. longa. Ovarium 2-loculare 4-ovulatum disco glabro terminatum. Fructus globosus, glabrescens, margine libero receptaculi saepe 8-fisso sepalisque coronatus, in sicco circ. 8 mm. in diametro, monospermus; cotyledonibus plicatis, radicula elongata plicata.

TYPE: Kurupung, Upper Mazaruni River, *Herbert Leng 298* fl. Dec. New York Botanical Garden. *Leng 212* fl. Nov. (NY); Makrebafalls, Kurupung River, *Pinkus 261* fr. (NY); Macouria creek, *Jenman 2389* fl. Nov. (NY, K); ibidem, *2388* (K); *F.D.* (*Anderson*) *295* fl. fr. March (K). Nearly allied to *M. insculpta* Diels, this latter species differing by its larger leaves, in which the lateral nerves are impressed above and the venation more prominent beneath. *Aulomyrcia tobagensis* (Kr. et Urb.) Amsh., of which the adult flowers are not known, is also very similar in leaf-characters

and general habit, but its flowers are glabrous and ± long-pedicelled. Among the Guiana species only *M. Guildingiana* Griseb., with quite glabrous inflorescences, has a similar structure of the calyx.

AULOMYRCIA DIVARICATA Berg (IV 4). BRITISH GUIANA: undergrowth tree 30′ high, 6″ diam, with red papery bark and very hard, fine-grained wood from Kakaralli bush on brown sand, flowers white, bunched 3 and 4 together at ends of branchlets of a compound panicle, stamens white, ovary and buds greenish, Mazaruni Station, *F.D. 3368*. Also collected along the Corantijne River in British Guiana and along the Surinam River in Surinam.

AULOMYRCIA LUCIDA Berg var. (IV 6). SURINAM: frequent, tree 8 m. high, 10 cm. in diam., flowers white, fruit red, mixed high forest, base of cliffs, west escarpment, Tafelberg, *24693*. Described from Southern Brazil. Maguire *24693* comes very near the var. *grandifolia* Berg, but the flowers are somewhat larger and the venation more obsolete.

Aulomyrcia citrifolia (Aubl.) Amsh. comb. nov., *Myrtus citrifolia* Aubl., Pl. Guiane Fr. **1**: table des noms 20. 1775, **2**: 513, no. 4. 1775. *Myrcia citrifolia* (Aubl.) Urb. in Fedde Rep. **16**: 150. 1920; *Myrcia paniculata* (Jacq.) Kr. et Urb. in Engl. Bot. Jahrb. **19**: 577. 1895. (IV 7). SURINAM: frequent, shrub 2 m. high, fruit red, Savanna II, Tafelberg, *24703;* frequent, shrub to 2 m. high, flowers white, Savanna VIII, Tafelberg, *24526;* frequent, shrub to 2 m., inflorescence and buds red, flowers white, Savanna VIII, extensive rock and pigmy bush openings, Tafelberg, *24442;* shrub to 2 m., leaves obovate, flowers white, Savanna II, Tafelberg, *24229*. West Indies, Brazil (Kiaersk). I can find no significant differences between the variable Tafelberg collection and the also variable West Indian form. The species is not otherwise known from Guiana, unless *Aulomyrcia triflora* Berg, in which the greatest width of the leaves tends to be below the middle instead of above the middle, has to be considered as a variety. The type of *A. triflora* Berg is *Rich. Schomburgk 978 = Rob. Schomburgk 644*, but the inflorescence is not on all sheets of this collection so contracted and few-flowered as described by Berg. A lax-flowered form with the leaves of *A. triflora* Berg has been collected by *Pinkus 33*, [N. Y.] and *F. D. 2785*, [K], along the Membaru Creek, Upper Mazaruni River in British Guiana.

AULOMYRCIA OBTUSA (Schauer) Berg (IV 8). SURINAM: frequent, shrub to 2–3 feet high, divaricate, flowers white, wet sand, Zanderij I, *23724;* shrub, wet sand, savanna, Zanderij I, *23728a;* shrub, south savanna, vicinity Arawak village of Mata, *24961;* shrub to 3 m. high, flowers white, fruit red, savanna vicinity Sectie O, km. 68, *25019*. With several varieties from Brazil to Trinidad, especially frequent in Surinam, not yet known from French Guiana.

Aulomyrcia platyclada (DC.) Amsh. comb. nov., *Myrcia platyclada* DC., Prodr. **3**: 224. 1828; *Aulomyrcia dumosa* Berg in Linnaea **30**: 656. 1861; *Myrcia dumosa* (Berg) Kr. et Urb. in Engl. Bot. Jahrb. **19**: 580. 1895. British Guiana; im Walde unterhalb des Roraima, *Ule 8672* (U, L, K). Martinique, Guadeloupe, Trinidad, Tobago, British Guiana, Surinam, French Guiana. I was able to compare a fragment and a duplicate of the type of *Myrcia platyclada* DC., collected by Patris in French Guiana. *Aulomyrcia dumosa* Berg was described from French Guiana also; its type, with flowers and fruits, has been studied by Urban in the Berlin

herbarium. I studied the West Indian specimens identified by Urban as *A. dumosa* Berg and a photo of the (fruiting) duplicate type in the Paris herbarium.

Var. **kaieteurensis** Amsh. var. nov. A typo differt foliis rigidioribus obsolete venosis inflorescentia glabra.

TYPE: frequent, shrub to 4 m. high, 2–3 cm. diam., lax open growth, inflorescence reddish, flowers not open, from bush island on savanna, Kaieteur Plateau, *Maguire & Fanshawe 23268*. Cotypes: frequent, shrub to 2 m., 2 cm. diam., fruit oblong-globose, crimson, from bush island on savanna, Kaieteur Plateau, *Maguire & Fanshawe 23300;* Kaieteur savanna, thickets on rocky ground, alt. 1200 feet, small tree, fruit dull red, leaves leathery, *Sandwith 1334* (U, K). A rather distinct form, perhaps deserving more than varietal rank, but with the characteristic flattened rachis of the inflorescence to which the specific name refers.

AULOMYRCIA HOSTMANNIANA Berg (IV 10). SURINAM: shrub to 4 m. high, flowers white, south savanna, vicinity Arawak village of Mata, *24978*. Frequent throughout British Guiana and Surinam; also cited for northern Brazil (Kiaersk).

Aulomyrcia albido-tomentosa Amsh. sp. nov. (IV 17). Frutex vel arbor para ramulis dense albido-tomentoso-pubescentibus. Folia ovato-oblonga, apice breviter acuminata basi acuta et in petiolum attenuata, chartacea vel coriacea, juniora albido-pilosa adulta glabra utrinque praesertim subtus conspicue impresso-punctata 5–9 cm. longa 2–4 cm. lata costa supra impressa subtus prominente nervis lateralibus numerosis inconspicuis utrinque tenuiter impressis nervo marginali circ. 1 mm. a margine remoto venis obsoletis. Petiolus usque ad 5 mm. longus. Paniculae axillares et terminales pauciflorae interdum racemiformes folio breviores, pubescentes. Flores tetrameri; receptaculum supra ovarium productum extus dense albido-pubescens intus margine inter stamina breviter pubescenti excepto glabrum. Sepala imbricata 2 exteriora 2 interiora, ciliata, extus sparse pubescentia intus sericea 1 mm. longa. Petala 4, orbicularia 2½ mm. longa. Ovarium 2-loculare 4-ovulatum, ovulis ascendentibus. Baccae (immaturae tantum adsunt) globosae; cotyledones liberae; radicula elongata.

TYPE: Kaieteur savanna, British Guiana, thickets on rocky ground, alt. 1200 feet, *Sandwith 1392* fl. Sept. 1937, (U, K). A small tree, flowers white, ibidem, *Sandwith 1344* fl. Sept. (U, K). COTYPE: frequent, small tree 10 m. high, 10 cm. diam., overhanging lower Augustus Creek, Tafelberg, Surinam, *Maguire 24734,* defl. Sept. SURINAM: frequent, tree 10 m. high, 10 cm. diam., transition high-low bush, 5 km. southwest of Savanna I, Tafelberg, *Maguire 24783* defl. Sept.; small tree to 8 m. high, 5 cm. diam., flowers white, dense, wet, low bush north of Savanna III, Tafelberg, *Maguire 24274* fl. (buds) Aug.

A very distinct species, well characterized by its indumentum and its conspicuously punctate leaves. Because of its 4-merous flowers it belongs to that artificial group of *Aulomyrcia* species, formerly united by Berg to the genus *Myrciaria* Berg as "series paniculatae."

AULOMYRCIA MINUTIFLORA (Sagot) Amsh. (IV 18), *Myrcia minutiflora* Sagot in Ann. Sc. Nat. 6^{20}: 185. 1885. BRITISH GUIANA: slender shrub 3–5 m. high, dense forest, northern slope of Akarai Mountains, *A. C. Smith*

2902. Otherwise known to me only from the type collection, made by Mélinon on the French side of the Marowijne River. The species is readily recognizable by its caudate leaves and few-flowered inflorescences; in fruiting specimens often only one fruit of an inflorescence is developed, thereby reminding one of a Eugenia. The minute flowers are 4-merous, the sepals hardly imbricate, and, as Sagot suggested, this species is rather similar to some Marliereas.

MYRCIA BRACTEATA (Rich.) DC. (V 1). SURINAM: frequent, small tree to 5 m. high, in medium bush, 2 km. south of East Ridge, Tafelberg, *24598.* Guiana (apparently only in the interior), n. Brazil, e. Peru.

MYRCIA SYLVATICA (Mey.) DC. (V 2). BRITISH GUIANA: occasional, 3 m. tree, 3 cm. diam., buds reddish, all parts pubescent, of bush island on savanna, Kaieteur Plateau, *23440.* SURINAM: frequent, shrub or small tree, flowers white, along southwest escarpment, Tafelberg, *24637.* Guiana and Brazil, one of the most common and best known species.

MYRCIA FALLAX (Rich.) DC., Prodr. **3**: 224. 1828; Berg in Linnaea **27**: 98. 1855; ***Eugenia fallax*** Rich. in Act. Soc. hist. nat. Paris **1**: 110. 1792; ***Myrcia Berberis*** DC., Prodr. **3**: 244. 1828; Berg in Mart. Fl. Bras. **14**[1]: 170. 1857; ***Myrcia Kegeliana*** Berg **14**[1]: 168. 1857. (V 4). BRITISH GUIANA: occasional, 5–8 m. tree, 10 cm. diam., leaves stiff, leathery, fruit purple-black ripe, white-suffused, pale magenta when young, from low wallaba bush, Kaieteur Plateau, *23212;* frequent to common, 6 m. tree, 10 cm. diam., leaves chartaceous, fruit oblong, red-mauve, not yet ripe, leaning over river, Kaieteur Plateau, *23304.* The type of *Eugenia fallax* Rich. was collected by Leblond in French Guiana; there is a sheet in the Herbarium Delessert, Genève, with flowers and young fruits, and one in the Herbarium Richard, now incorporated in the Paris herbarium, with young fruits only. The specimen described by Berg in 1855 came from the Herbarium Willdenow (B); it is possibly the same species but probably not collected by Leblond. Widely distributed from the West Indies to Brazil.

MYRCIA DEFLEXA (Poir.) DC. (V 5). SURINAM: tree 20 m. high, 30 cm. diam., fruit turning white, high bush, south cliffs Arrowhead Basin, Tafelberg, *24455;* frequent, small tree, flowers white, twigs red-tawny, high forest, south slopes, Arrowhead Basin, Tafelberg, *24602.* West Indies, Venezuela, Guiana, Brazil. To this species also belongs *Myrcia crassinervia* DC., Prodr. III (1928) p. 245, described from French Guiana; I was able to consult a duplicate and a fragment of the type.

Myrcia tafelbergica Amsh. sp. nov. (V 6). Frutex vel arbor parva. Ramuli juniores dense rufo-velutini. Folia ovata vel oblonga, basi obtusa, acuta vel rotundata, apice acuminata, 2–8 cm. longa 1–3. 5 cm. lata, juniora sparse pilosa, adulta costa excepta glabra, coriacea, in sicco ± rugosa, costa supra impressa, subtus prominente, nervis lateralibus venisque obsoletis. Petiolus robustus, 5 mm. longus. Paniculae axillares et subterminales, rufo-velutinae, pauciflorae, usque ad 4 cm. longae. Flores 7–9 mm. in diametro; receptaculum extus sericeum; sepala utrinque sericea; petala extus pubescentia. Ovarium 2-loculare disco sericeo terminatum. Bacca subglobosa, disperma, glabrescens, cotyledonibus plicatis, radicula elongata.

TYPE: frequent, shrub to 4 m. high, leaves opposite, acuminate, flowers white, extensive rock and pigmy bush openings, alt. 776 m., Savanna VIII, Maguire *24441.* **COTYPE**: frequent, shrub to 3 m. high, leaves acuminate,

flowers white, Savanna VIII, Tafelberg, 776 m. alt., *Maguire 24572*. SURINAM: frequent, small tree in open low bush between camps 2 and 1, Tafelberg *24647;* small tree, low bush, Savanna II, *24235;* frequent, shrub to 3 m., leaves acuminate, flowers white, Savanna II, *24233;* tree in moeri-moeri, *Geyskes* 988 fr. (U). Closely allied to *M. Schomburgkiana* Berg, the latter species differing by its narrower leaves with acuminate base, prominulous venation, slender petiole, and, as far as known, by its narrowly ellipsoid, 1-seeded fruit.

MYRCIA SCHOMBURGKIANA Berg (V 7). BRITISH GUIANA: frequent to common, tree to 6 m. high, fruit reddish, usually drooping over river, secondary forest on white sand, Waratuk Falls, Potaro River Gorge, *23039*. The specimen is imperfect and the determination therefore somewhat tentative. Frequent in British Guiana; once collected along the French side of the Marowijne River; not yet known from Surinam.

CALYCORECTES GRANDIFOLIUS Berg (VIII 1). SURINAM: infrequent, small tree, leaves chartaceous, fruit pale buff, Saramacca River banks below rapids, Jacob kondre, *23834;* frequent, shrub to 2 m. high, fruit becoming cream-colored, dakama forest, bottom of Arrowhead Basin, Tafelberg, *24619,* a somewhat aberrant, small-leaved form. Surinam and French Guiana, (a.o. *Sagot 943* [P, U, K], *Benoist 430* [P], *Wachenheim 480* [P]; *Poiteau s.n.* [G. DEL]; *Martin s.n.* [P]). Confused by Miquel in Linnaea XXII (1849) p. 172 and Stirpes Sur. Sel. (1850) p. 39 and by Sagot in Ann. Sc. Nat. 6.20 (1885) p. 193 with *Eugenia ramiflora* Desv., which is a true Eugenia.

CATINGA MOSCHATA Aubl. *Calycorectes latifolius* (Aubl.) Berg in Linnaea **30**: 701. 1861 quoad descript. tantum, non quoad nomen; *Calycorectes Bergii* Sandw. in Kew Bulletin (**1932**) 212. (IX 2). BRITISH GUIANA: frequent, large tree, dense second growth, in windfall opening, heavy *Mora* forest, Kamuni Creek, Groete Creek, Essequibo River, *22925;* frequent, tree 18 m. high, 20 cm. diam., dense second growth in windfall opening, heavy *Mora* forest, Kamuni Creek, Groete Creek, Essequibo River, *22865*. Guiana. This and a second interesting species of the same genus will be discussed in a later paper.

PLINIA DUSSII (Kr. et Urb.) Urb. *Marlierea Dussii* Kr. et Urb. SURINAM: tree to 12 m. high, 25 cm. diam., flowers white, low bush, vicinity of Savanna II, Tafelberg, *24263;* rare shrub to 4 m. high, flowers white, border pigmy bush, Savanna VIII, Tafelberg, *24425*. Guadeloupe, Martinique. Not otherwise known from Guiana or the continent. I am convinced that the species does not belong to the genus *Plinia* L., but prefer to await the examination of fruiting material before making a transfer.

EUGENIA WENTII Amsh. (XI 1). SURINAM: slender tree to 5 m. high, 5 cm. diam., sepals green, petals white, high mixed forest, overhanging stream, North Ridge Creek, Tafelberg, *24665*. Surinam and French Guiana.

EUGENIA ATROPUNCTATA Steud. (XI 11). SURINAM: shrub or small tree, flowers white, pink in bud, riverside above Posoegronoe, Saramacca River, *24037;* frequent, small tree, flowers white, vicinity island camp, Toekoemoetoe Creek, *24072*. Surinam and East Peru.

EUGENIA EURYCHEILA Berg. BRITISH GUIANA: tree to 5 m. high, low forest, basin of Rupununi River, Karenambo, *A. C. Smith 2213;* slender tree 5 m. high, petals and filaments white, edge of forest, basin of Rupununi River, near mouth of Charwair Creek, *A. C. Smith 2355;* slender tree 3–4 m.

high, on exposed rock ledges, western extremity of Kanuku Mountains, in drainage of Takutu River, dense forest, *A. C. Smith 3135;* slender shrub 3 m. high, mature fruit rich brown, northwestern slopes of Kanuku Mountains, in drainage of Moku-Moku creek (Takutu tributary), dense forest, *A. C. Smith 3379.* Otherwise only known from the type collection (Rupununi River, British Guiana, *Rich. Schomburgk 1295* [P]).

EUGENIA BIFLORA L. var. (XI 9). BRITISH GUIANA: shrub or small tree to 6 feet tall, leaves linear, thick, somewhat leathery, pubescent beneath, flowers in terminal inflorescences, white, stamins numerous, fruit yellow, globose, topped by calyx remains, Takutu Creek to Puruni River, Mazaruni River, *F. D. 4909.* Very similar to the French Guiana form, described by Sagot as *E. myriostigma* Sagot.

EUGENIA EXCELSA Berg (XI 29). BRITISH GUIANA: shrub or small tree, leaves leathery, flowers in groups in the axils, buds pinkish, flowers white, Takutu to Puruni River, Mazaruni River, *F. D. 4827.* Not otherwise known from British Guiana. Surinam and Brazil.

EUGENIA RAMIFLORA Desv. ex Hamilton, Prodr. Fl. Ind. Occ. 44. 1825; *Eugenia brachypoda* DC., Prodr. **3**: 274. 1828; *Eugenia fulvipes* Sagot in Ann. Sc. Nat. **6**[20]: 189. 1885. (XI 17). SURINAM: slender shrub to 4 m. high, densely shaded lateral channel along riverbanks en route to Kwatta hede, Saramacca River, *23953;* tree 4 m. high, flowers pink to white, in virgin forest along the Saramacca River, *Pulle 408* (U). FRENCH GUIANA: Marowijne River, *Mélinon s.n.* (P, K, NY), type of *Eugenia fulvipes* Sagot; ididem, *Wachenheim 17* (P). The types of *E. ramiflora* Desv. and *E. brachypoda* DC. were also collected in French Guiana, but the collector and the locality are not known. I have now been able to examine the types, thanks to the courtesy of the Director of the Paris Herbarium. The specimen has been well preserved and the photo is quite distinct, so that I have no doubt of its identity. Of *E. brachypoda* DC. I was able to examine a fragment and a duplicate (in G-DEL) of the type. It appears that *E. brachypoda* DC. was not correctly interpreted by Sagot in Ann. Sc. Nat. **6**[20]: 190. 1885, and consequently by myself in Med. Bot. Mus. & Herb. Utrecht 86 (1942) p. 162; the specimen of Leprieur, cited by Sagot, belongs in reality to *E. chrysophyllum* Poir. *E. ramiflora* Desv. is among the Guiana species of *Eugenia* well characterized by the arachnoid pubescence of the young leaves and by the short sepals; the arachnoid hairs are persistent on parts of the lower surface of the adult leaf. The Amazonian *E. Ferreireana* Berg is, however, very closely allied.

var. **montana** Amsh. var. nov. A typo differt foliis angustioribus longe falcato-acuminatis demum totis glabratis.

TYPE: slender tree or shrub to 4 m., rim Arrowhead Basin, 725 m. alt., Tafelberg, *Maguire 24481* fr. Aug. Surinam, Emmarange, top II, *B. W. 5700* fl. Nov., (U).

Eugenia tafelbergica Amsh. sp. nov. Frutex vel arbor parva ramulis novellis sulcato-compressis adpresse-pubescentibus, demum subteretibus glabratis. Folia oblonga apice longe acuminata basi in petiolum attenuata, membranacea, novella utrinque sparse breviter adpresse-pubescentia, glabrescentia, adulta glabra, 8–12 cm. longa 3–4 cm. lata, minute dense pellucido-punctata, costa supra impressa subtus prominente nervis lateralibus utroque latere 12–14 supra prominulis, nervo marginali 2–3 mm. a mar-

gine remoto, venis reticulatis. Petiolus canaliculatus ad 1 cm. longus. Flores fasciculati vel breviter racemosi, 2–4-ni, interdum solitarii, bracteis minutis suffulti, pedicellis sericeis 6–10 mm. longis. Bracteolae triangulari-ovatae minutae. Sepala extus sparse adpresse-pubescentia, intus sericea, semiorbicularia, in alabastro petala includentia, inaequalia, exteriora 2 mm., interiora fere 3 mm. longa. Petala fugacia. Ovarium adpresse-pubescens, 2-loculare, loculis circ. 8-ovulatis. Fructus ignotus.

TYPE: shrub, flowers white, opening in *Clusia* bush, 1 km. west of East Ridge, Tafelberg, *Maguire 24599* fl. Sept. COTYPE: tree to 5 m. high, 6 cm. diam., flowers white, in medium bush, 1.5 km. south of East Ridge, *Maguire 24583* fl. Sept. closely allied to *Eugenia armeniaca* Sagot from French Guiana. This latter species differs by its leaves, which even when adult are densely sericeous beneath, by the lateral nerves, which are conspicuously arcuate-anastomosing, and by its subterete petiole. The flowers and inflorescence are very similar.

Eugenia kaieteurensis Amsh. sp. nov. Frutex ramulis compressis, minute puberulis, glabrescentibus. Folia obovata, apice rotundata interdum leviter emarginata vel brevissime obtuse acuminata, basi acuta, coriacea, 9–14 cm. longa 4–7 cm. lata, discoloria, supra glabra subtus pallidiora minute puberula, costa supra plana subtus prominenti, nervis lateralibus circ. 10 supra prominulis subtus leviter prominentibus, nervo marginali 1–2 mm. a margine remoto, venis laxe reticulatis utrinque prominulis. Petiolus crassus subteres 5–8 mm. longus. Inflorescentiae breviter fasciculato-racemosae, rachi usque ad 5 mm. longa, pluriflorae; bracteae minutae, deciduae; pedicelli brunneo-sericei, 3–10 mm. longi; bracteolae ovatae, vix 1 mm. longae; receptaculum brunneo-sericeum; sepala rotundata, utrinque minute sericea, parum inaequalia, 1.5–2 mm. longa. Petala membranacea, glabra, ± 3 mm. longa. Ovarium 2-loculare, loculis in flore unico dissecto 7-ovulatis. Fructus oblongo-ellipsoideus, puberulus, immaturus 12 mm. longus 7 mm. in diametro, monospermus, embryo homogeneus.

TYPE: a tree 15 or more feet high, Kaieteur Savanna, Potaro River, British Guiana, *Jenman 808* fl. Sept./Oct. 1881 (K). COTYPE: Kaieteur Plateau, bush island in savanna, rare 2 m. shrub, fruit oblong, pale-orange, *Maguire & Fanshawe 23444* fr. May 1944. Evidently closely allied to *E. Baileyi* Britton of Trinidad, the leaves very similar, but differing by its pedicellate flowers and fruits, the shorter indumentum of the inflorescence, and the somewhat smaller flowers.

EUGENIA COMPTA Berg in Linnaea **31**: 677, 1861; *Eugenia Prieurii* Berg in Linnaea **30**: 681. 1861; *Eugenia Prieurei* Sagot in Ann. Sc. Nat. **6**[20]: 188. 1885. (XI 23). SURINAM: along rail-road near km. 70, *23613;* and a few other collections. FRENCH GUIANA: vicinity of Cayenne, in bush along public road, *Broadway 256* fr. May (NY); hill above Grants Road, *Broadway 756* fr. July (NY); *Broadway 417* fr. June (NY); Sinnamarie, Béna? *2306* (U); without locality, *Richard s.n.* (P), type of *E. compta* Berg; *Leprieur s.n.*, type of *E. Prieurii* Berg and *E. Prieurei* Sagot (P, BM, L, NY, U); *Mélinon 74* (U); *Gabriel* anno 1802 (G-DEL); *Poiteau s.n.* (G-DEL); *von Rohr 171 and 214* (BM).

EUGENIA ANASTOMOSANS DC. (XI 25). BRITISH GUIANA: occasional, small tree 3 m. high, fruit oblong-ovoid, black, glossy, crowned by dark green calyx lobes, fruit edible, astringent, Kaieteur Plateau, *23197;* rare,

small tree to 5 m. high, 5 cm. diam., leaves leathery, calyx dark green, fruit oblong, black, fleshy, 2×1.5 cm., rocky *Dicymbe* forest, trail from Tukeit to Kaiateur Falls, on Kaieteur escarpment, *23074;* a small tree, flowers on old wood, petals white, in forest on white sand, Potaro River, between Garraway stream and Kangaruma, *Sandwith 1238* (U, K); shrub, 10 feet, flowers white, Demerara County, on white sands, along the Berbice-Rupununi Cattle Trail, *Abraham 310* and *319* (NY); Berbice River, *Hohenkerk 295C* (K); Winiperu Creek, Demerara River, *F. D. 3110* (K). SURINAM: shrub 1.5 m. high, overhanging west Escarpment, Tafelberg, *24674;* shrub to 2 m. high, infrequent, leaves subcoriaceous, Savanna II, Tafelberg, *24706;* shrub to 2 m. high, Savanna IV, Tafelberg, *26172*. Not otherwise known from Surinam. FRENCH GUIANA: Marowijne River, *Wachenheim 77* (P); Godebert, *Wachenheim 373* (P, U); without locality, *Martin s.n.* type, duplicate in L and P; *Poiteau s.n.* (K), mixed with *E. Poiteau* Berg. The species belongs, with the Jamaican *E. Marchiana* Griseb., the Guiana *E. latifolia* Aubl. (non aliis auct.), and a few others to a group of species with mostly large subtriplinerved leaves, relatively large, fasciculate, lateral flowers and oblong-ellipsoid fruits. The leaves are shortly obtusely acuminate, obtuse or rounded at the apex, more or less coriaceous, and rather variable in size.

EUGENIA PUNICIFOLIA (H. B. K.) DC. (XI 26). BRITISH GUIANA: occasional, shrub, leaves chartaceous, fruit scarlet, ovoid, from bush island on Kaieteur Savanna, *23196*. SURINAM: rare, shrub to 1 m. high, savanna, Zanderij I, *23725*. In several varieties from Cuba to Brazil.

EUGENIA TAPACUMENSIS Berg (XI 27). SURINAM: small tree, fruit black, Gran Dam Rapids, Saramacca River, *24014*. Guiana, east Peru, Martinique, St. Vincent.

EUGENIA FLAVESCENS DC. (XI 28). SURINAM: tree to 10 m. tall, 10 cm. diam., leaves bright green, swampy bush above village along Saramacca trail, Jacob kondre, *23877*. Guiana, Brazil, Bolivia.

EUGENIA SCHOMBURGKII Benth. (XI 32). BRITISH GUIANA: Rupununi River, *Schomburgk 703,* type (K, G-DEL, L); *F. D. 2060* (K). Kurupung, Upper Mazaruni River, *Leng 258* fr. Nov. (NY). SURINAM: tree 12 m. high, fruit yellow, turning black, along riverbanks from Campo Dungeoman to Toekoemoetoe Creek, Saramacca River, *24063*. Frequent in Surinam. The ovary, described by Berg in Linnaea **27**: 198 (1856) as 3-celled, was in all flowers dissected by me 2-celled.

EUGENIA sp., not matched. SURINAM: shrub 2 m. high, immature fruit red, wallaba forest and swamp, vicinity Base Camp, Tafelberg Creek, *24091*. The specimen bears fruits only and does not belong to any *Eugenia* species already known from Guiana.

EUGENIA sp., not matched. BRITISH GUIANA: rare, 14 m. tree, 18 cm. diam., fruit green, *Dicymbe* forest on lateritic soil, along Potaro River below Tukeit, *23509*. Probably allied to *Eugenia latifolia* Aubl., but the flowers not known.

PSIDIUM PARVIFLORUM Benth. var. **saramaccense** Amsh. var. nov. (XIII 8). A typo differt inflorescentia floribusque glabris.

TYPE: common, small shrub to 3 m. high, flowers white, Gran Dam, Saramacca River, *Maguire 24930* fl. Oct. The flowers are quite glabrous, even the calyx inside. In a form collected along the Coppenam River in

Surinam the calyx is sericeous inside, as in typical *Ps. parviflorum* Benth. It is possible that some species described from Brazil must also be regarded as varieties of the same species. Typical *Ps. parviflorum* Benth. seems to be restricted to British Guiana (Rupununi and Essequibo Rivers) and to the adjoining part of the Brazilian state of Amazonas (Rio Branco, *Ule 7713* [L]).

PSIDIUM OVATIFOLIUM Berg. var. **glabrum** Amsh. var nov. A typo differt inflorescentia glabra.

TYPE: lax shrub to 4 m. high, growing in water, basin of Rupununi River, Karenambo, British Guiana, lat. about 3° 45′ N., *A. C. Smith 2253,* (U, NY, K), distributed as *Psidium aromaticum* Aubl., Rupununi River, F. D. (*Anderson*) 686 (K).

A predominant plant in riverside thickets, associated with *Ps. parviflorum* Benth. In the Kew herbarium there are two specimens of *Ps. ovatifolium* Berg, one a densely pubescent form, collected by *Spruce* anno 1850, in the vicinity of Santarem, Prov. Pará, duplicate of the type, the other a more glabrate form, *Spruce 1032,* along the shores of the Tapajoz River, Pará.

CALYCOLPUS REVOLUTUS (Schauer) Berg. (XIV 1). SURINAM: shrub, flowers white, south savanna, vicinity Arawak village of Mata, *24973.* French Guiana and Surinam.

MELALEUCA LEUCODENDRON L. BRITISH GUIANA: 16 m. tree, 30 cm. diam., grey flaky bark, flowers white, fruit grey-brown, woody, introduced, vicinity Mazaruni Forest Station, *23563.* Native of tropical Asia and Australia.

MELASTOMACEAE[101]

Since my summary of the Melastomaceae of British Guiana, published in 1932, presented the results of about a century of botanical exploration in that colony, it is scarcely to be expected that the few years since elapsed would add much to the list of known species. Nevertheless, collections by Sandwith, Tutin, and Smith were all productive of a few undescribed species, and the recent expedition of Maguire has added a few more. It has been my privilege to examine the melastomes collected on this, the most recent expedition, and my identifications are given below. The sequence of genera is that adopted in my Synopsis (Brittonia **1**: 127–184. 1932) and page references are given to that paper.

TRIBE I. MICROLICIEAE

SIPHANTHERA JENMANI Gleason (137). BRITISH GUIANA: frequent, perennial herb, with leaves adpressed to stem, petals and stamens pink, sandy soil between low bush islands, Kaieteur Savanna, *23161.* Known only from the Kaieteur Plateau.

SIPHANTHERA CAPITATA Gleason (137). BRITISH GUIANA: rare, annual herb 10 cm. high, petals pink-mauve, anthers purple, on bare rock surface, Kaieteur Savanna, *23451; 23479.* Known only from the Kaieteur Plateau.

SIPHANTHERA HOSTMANNII Cogn. (139). SURINAM: shallow bogs, Savanna I, Tafelberg, *24222a.* Surinam; probably to be expected in British Guiana.

[101] By H. A. Gleason.

TRIBE II. MERIANEAE

ADELOBOTRYS GUIANENSIS (DC.) Gleason (141). SURINAM: frequent, liana, petals flesh-colored, anthers and filaments white, processes yellow, leaves glossy green, subchartaceous, precipitous east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24557;* frequent, vine, leaves glossy green above, in medium bush, 1.5 km. south of East Ridge, Tafelberg, *24590*. The most abundant species in northern South America.

ADELOBOTRYS sp. SURINAM: frequent, vine, climbing, no fruiting or flowering material seen, high dakama forest, 0.5 km. south of East Ridge, Tafelberg, *24578*.

Adelobotrys laxiflora Triana was first collected "in Guiana Anglica ad flum. Essequibo" by C. F. Appun and his specimen is preserved in the herbarium at Kew. It exhibits four leaves and several inflorescences of postmature fruit. Since then it has been collected at least five times, by Jenman, Linder, and Sandwith, and always only in fruit (Synopsis, 140, 141).

In comparison with other species of *Adelobotrys* it is quite anomalous. The leaves are alternate instead of opposite, with very little trace of the abortive member of the pair. Malpighian hairs are lacking. Pubescence of the stem is glandular, at least in part, instead of simple. The fruits are loosely paniculate instead of umbellate.

Maguire has at last discovered the plant in flower and has prepared excellent herbarium specimens which show still other features in which it differs from *Adelobotrys*. The calyx is calyptriform, instead of open in the bud. The stamens are almost isomorphic, instead of strongly dimorphic. The connective is expanded at base into a large, dark-colored, cordate organ, with a single dorsal and two ventral lobes, and completely lacks the long dorsal appendages of *Adelobotrys*. These numerous and important differences from *Adelobotrys* and all other described genera of the family warrant the erection of a new genus:

Phainantha Gleason, gen. nov. Hypanthium obconicum. Calyx calyptriformis ad torum deciduus. Flores 4-meri. Stamina fere isomorpha; antherae subulatae; connectivum crassum carnosum fuscum 3-lobum, lobo uno dorsali ad thecas adpresso, lobis duo ventralibus rotundatis. Ovarium superum 4-loculare. Folia alterna petiolata. Inflorescentia axillaris vel terminalis paniculiformis. Capsula elongata 4-locularis, calyce persistenti inclusa.

The tribe of the family to which *Phainantha* should be referred is still conjectural, since no mature seeds are available.

Phainantha laxiflora (Triana) Gleason, comb. nov. *Adelobotrys laxiflora* Triana, Trans. Linn. Soc. **28**: 68. 1871. The extant specific descriptions may now be supplemented by the characters of the flowers: hypanthium pink, obconic, about 6 mm. long, sparsely beset with spreading glandular hairs about 1 mm. long; petals pink, narrowly obovate, about 6 mm. long; filaments 2.1–2.4 or 1.7–1.8 mm. long, glabrous; anthers 2.2 or 1.5–1.8 mm. long. BRITISH GUIANA: occasional; climbing vine with fleshy red-nerved leaves, appressed to tree trunk; pubescence reddish; flowers pink, secondary forest, Waratuk Falls, Potaro River Gorge, *23033;* wallaba forest, Kaieteur Plateau, *23229*.

GRAFFENRIEDA OVALIFOLIA Naud. (142, under *G. Weddellii*). BRITISH GUIANA: rare, shrub or small tree to 4 m. tall, 8 cm. diameter, leaves leath-

ery, fruit urceolate, purple-brown, low bush island fringe, Kaieteur Savanna, *23183*. Hitherto known only from the vicinity of Mount Roraima, in northern Brazil and southern Venezuela.

GRAFFENRIEDA CARYOPHYLLAEA Triana. BRITISH GUIANA: occasional, shrub to 1.6 m. tall, stems quadrangular, leaves leathery, petals white, stamens yellow, margins of bush islands, Kaieteur Savanna, *23131*. Tentatively referred to this species, since the specimen is in fruiting condition only; new to British Guiana. Distinguished from the known species (142) by its coriaceous, short-petioled, 3-nerved leaves with the lateral nerves submarginal.

TRIBE III. BERTOLONIEAE

MACROCENTRUM CRISTATUM (DC.) Triana (145). BRITISH GUIANA: annual herb to 30 cm. high, leaves pale green, petals white, anthers crimson, rock surface, rare, trail Tukeit to Kaieteur Plateau, *23085;* locally common, damp rocks, Waratuk Portage, Potaro River Gorge, *23542*. Probably throughout the colony.

MACROCENTRUM VESTITUM Sandwith (145). BRITISH GUIANA: locally common, annual herb, to 8 cm. high, leaves hispid, outside half of petal crimson, filaments white, on rock surfaces, trail from Tukeit to Kaieteur Plateau, *23070;* flowers crimson, occasional, on moist rocks, Amatuk Portage, *23027*. Endemic to river and rapids habitats in British Guiana.

MACROCENTRUM DROSEROIDES Triana (145). BRITISH GUIANA: rare, annual herb to 5 cm. high, flowers crimson, fruit capsules brown, on moist rocks, trail from Tukeit to Kaieteur Plateau, *23082*. Endemic to river and rapids habitats in British Guiana.

MACROCENTRUM FASCICULATUM (L. C. Rich.) Triana (145). SURINAM: common, petals white flushed with pink, anthers yellow, under drips, high bush, base north escarpment, Tafelberg, *24342;* infrequent, leaves reddish-green above, purple-red beneath, petals pink, anthers yellowish, pink-tipped, on damp, shaded walls of gorge above Lisa Falls, Tafelberg, *24368;* frequent, leaves purple-red beneath, moist cliffs, south base Arrowhead Basin, Tafelberg, *24465;* frequent, east-facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, *24552;* petals pale pink, anthers pale yellow, foot Augustus Falls, base north escarpment, mixed high forest, Tafelberg, *24746*. A comparatively rare species from the Guianas; a varietal form has been described from Peru and the species probably occurs elsewhere in the Amazonian forests. No. *24552* has unusually large leaves. French Guiana, Peru, intervening territory.

MACROCENTRUM FRUTICOSUM Gleason. SURINAM: locally abundant petals pink, filaments white, anthers pale yellow, forming dense cover on and among wet boulders, base Grace Falls, Tafelberg, *24515*. Endemic.

This, the largest species of the genus, was described from three collections from the mountains of Surinam. Attention was directed at that time to certain variations in the leaves. The recent collections by Maguire add two other variations: the leaves are distinctly 3-nerved and the flowers are 5-merous. Nevertheless, the original collections agree so closely with this one in all small details of flower structure that I am confident that they should all be referred to the same species.

Macrocentrum parvulum Gleason, sp. nov. Herbacea. Caules radices emittentes, 1–2 cm. longi, interdum parce ramosi, glabri, internodiis ca. 2

mm. longis. Folia 6–10, in quoque jugo aequalia vel fere aequalia. Petioli usque ad 7 mm. longi, glabri. Laminae tenues, ovato-oblongae, rotundo-ovatae vel rhombo-ovatae, 1–2 cm. longae, 5–12 mm. latae, obtusae vel subacutae, conspicuiter serrulatae, basi abrupte angustatae, ciliatae, supra setosae, subtus glabrae rubrae, 3-nerviae. Pedunculi terminales, 15–30 mm. longi. Flores 2–4, secundi, 4-meri; pedicelli usque ad 4 mm. longi. Flores maturi desiderantur. Sepala ex alabastro semicircularia, apiculata; dentes exteriores minuti, patuli; petala lanceolato-triangularia; stamina *Macrocentri.*

TYPE: frequent, delicate annual, petals pale pink, anthers purple, drier places under cliffs, Arrowhead Basin, 625 m. altitude, Tafelberg, Surinam, August 23, 1944, *Maguire 24469.* New York Botanical Garden. SURINAM: infrequent, single open flower, pale pink, hypanthium 2.6 mm. long, petals 5 mm. long, anthers and processes purple, opening in high bush, base of north escarpment, Tafelberg, *24320.*

Apparently *M. parvulum* is more similar to *M. cristatum* (DC.) Triana than to any other known species, but differs in its short internodes, setose, conspicuously serrulate leaves, and few flowers.

Macrocentrum montanum Gleason sp. nov. Herba verisimiliter annua, 5–10 cm. alta, caule glabro anguste 2-alato. Petioli 5–8 mm. longi. Laminae isomorphae, ovatae, usque ad 14 mm. longae 12 mm. latae, obtusae, spinuloso-serrulatae, basi rotundatae, supra sparsissime pilosae, pilis 0.4 mm. longis, subtus glabrae albo-punctatae. Flores 4-meri in racemis 2–4-floris, pedicellis glabris ca. 2 mm. longis. Hypanthium obconicum, 4.4 mm. longum, conspicuiter 8-costatum. Calycis tubus ca. 0.4 mm. longus, lobi late triangulares, acuti, 1.2 mm. longi, dentibus exterioribus nullis. Petala oblongo-oblanceolata, erecta, acuta, 5 mm. longa. Stamina 8, isomorpha; filamenta gracillima, 2.6 mm. longa; antherae subulatae, 2.7 mm. longae, poro terminali dehiscentes; connectivum infra thecas brevissime productum; calcar 2 mm. longum, sursum curvatum.

TYPE: rocky stream-bank at the foot of the Tafelberg, Surinam, *Maguire 24189.* New York Botanical Garden. Among the 4-merous members of the genus, our species is distinguished by its small size and few flowers from *M. fruticosum,* by its well developed calyx-lobes, narrow erect petals, and erect spur from *M. cristatum,* and from *M. parvulum* by its well developed internodes, green eciliate leaves, and the lack of exterior teeth on the calyx.

Diolena repens Gleason, sp. nov. Herba basi in muscis repens superne pendens, caulibus glabris 1–2 cm. longis. Folia valde dimorpha; majora elliptica 8–14 mm. longa, 3–6 mm. lata, patula, acuta, supra medium dentibus spinulosis 3–6 ornata, 3-nervia, venis secundariis obsoletis, utrinque glabra, petiolo 0.5–1 mm. longo; minora ovata 2–3 mm. longa 1-nervia, petiolo 0.2 mm. longo. Pedunculus solitarius terminalis 1-florus 2–5 mm. longus, breviter squamoso-pubescens. Hypanthium maturum poculiforme 2.2 mm. longum, squamoso-pubescens. Calycis tubus 0.5 mm. longus, lobi depresso-ovati purpurei adscendentes 1.5 mm. longi, margine spinuloso-eroso, dentibus exterioribus subulatis lobos 0.4 mm. excedentibus. Petala staminaque desunt. Ovarium superum 3-loculare. Fructus capsularis in hypanthio inclusus. Semina pyramidata 0.4 mm. longa.

TYPE: flowering stems pendent, calyx-lobes faintly purple, vertical moist

walls of Potaro River Gorge, 1 mile below Kaieteur Falls, British Guiana, May 13, 1944, *Maguire & Fanshawe 23426*. New York Botanical Garden.

Enough of the ovary has been seen to assign the plant definitely to the tribe Bertolonieae. Its dimorphic leaves are so suggestive of *Diolena pileoides* Triana that it has been assigned to that genus, although the actual diagnostic character lies in the stamens which are as yet unknown. Our species differs from other species of *Diolena* in its 1-flowered peduncles.

Diolena is primarily a genus of northwestern South America, including several species with large leaves in the lowlands of the upper Amazon and in Colombia and Peru, with others as far north as Guatemala. *D. pileoides* and its close relative *D. agrimonioides* are confined, so far as known, to the western side of the main range of the Andes. *D. repens* extends the known range of the genus about a thousand miles to the eastward.

The genus is distinguished from *Salpinga* and *Macrocentrum*, the only other members of the tribe in British Guiana, by the development of two slender spurs on the anther.

TRIBE IV. TIBOUCHINEAE

APPENDICULARIA THYMIFOLIA (Bonpl.) DC. (146). BRITISH GUIANA: rare, annual herb to 30 cm. high, pubescence glandular, flowers pink, crevices on bare rock surface, Kaieteur Savanna, *23452*. SURINAM: frequent, herbage red, petals pink-lavender, anthers greenish-yellow, processes purple, filaments white, shallow bogs, Savanna I, Tafelberg, *24207*. A rare little plant, hitherto known only from French Guiana and in British Guiana by a collection of *Jenman*, also from the Kaieteur Savanna.

The genus resembles *Ernestia* in its glabrous ovary and slender elongate anther-appendages; it differs in the sepals, which are nearly semicircular and broader than long.

ERNESTIA PULLEI Gleason. SURINAM: common annual, petals and anthers purple, filaments and appendages white, open sandy soil, islands in Brokoboto Rapids, 3 hours above Pakka Pakka, Saramacca River, *23992*. Endemic.

Ernestia minor Gleason, sp. nov. Caules debiles elongati, usque ad 6 cm. longi, rubri, dense minuteque pubescentes pilis glandulosis ca. 0.2 mm. longis. Petioli rubri, 5–8 mm longi, sicut caulis pubescentes. Laminae ovatae, usque ad 35 mm. longae 25 mm. latae, abrupte acuminatae, basi cordatae, minute denticulatae, ciliatae, 5-nerviae, utrinque minutissime denseque pubescentes pilis ca. 0.1 mm. longis. Inflorescentia terminalis, cymosa, pauciflora, 3–5 cm. longa, sicut caulis pubescens. Hypanthium tubulosum, 3 mm. longum, dense glanduloso-puberulum. Sepala lineari-lanceolata, 2.8 mm. longa, obtusa sicut hypanthium pubescentia. Stamina fere isomorpha; filamenta 4.1 vel 3.8 mm. longa; thecae subulatae rectae, 3.6 vel 3 mm. longae; connectivum incurvatum, 0.8 vel 0.5 mm. longum, in ser. ext. tuberculo dorsali ornatum; calcaria subulata erecta, 1.1 vel 0.9 mm. longa. Ovarium glabrum.

TYPE: locally frequent, petals pink, stamens white, climbing against wet walls of Grace Falls, Arrowhead Basin, 625 m. altitude, Tafelberg, Surinam, August 26, 1944, *Maguire 24514*. New York Botanical Garden. SURINAM: frequent, petals pale pink, anthers purple, under spray, base north escarpment, Tafelberg, *24322*.

Apparently only four of the described species of *Ernestia* have a glabrous ovary. *E. cordifolia* is a plant of western Venezuela with large setose leaves. *E. glandulosa* Gl., of British Guiana, has setose leaves and axillary inflorescence, but isomorphic stamens like *E. minor*. *E. Pullei* Gl., of Surinam, has strongly dimorphic stamens and short, broadly triangular sepals. *E. rubra* Pulle, also of Surinam, has leaves acute at base and short broad sepals.

Aciotis dysophylla (Benth.) Triana (149). British Guiana: locally frequent, herbaceous annual, with 4-angled stems, petals pink, anthers pale mauve, Tukeit, Potaro River Gorge, *23046*. Widely distributed in tropical South America.

Aciotis dichotoma (Benth.) Cogn. (149). British Guiana: low herb, flowers pink, Mazaruni Station, Mazaruni River, *M6*. Surinam, Trinidad, Venezuela.

Aciotis ornata (Miq.) Gleason (149). British Guiana: Takutu Creek to Puruni Road, Mazaruni River, *F2073;* Yarikita Portage, N.W.D., *F2443*. Surinam.

Aciotis laxa (L. C. Rich.) Cogn. (149). British Guiana: occasional to frequent, subshrub to 2 m. high, flowers white, in *Mora* forest, Kamuni Creek, Groete Creek, Essequibo River, *22812;* Garraway Stream, Potaro River, *22979;* east side Ikuruwa Lake, Canje River, *F.D. 657*. Surinam: frequent, petals white, pink-tipped, anthers pink, pubescent leaf-margins pink, in mixed high forest, dripping rocks, in spray at base north escarpment, Tafelberg, *24761;* flowers white, high mixed forest, south rocky slopes Arrowhead Basin, Tafelberg, *24610;* annual, petals pale pink, pubescence red, anthers deep pink, filaments white, savanna, Zanderij II, *25037;* annual, petals and filaments white, anthers purple-pink, savanna, east side, Zanderij I *25046*. An abundant and widely distributed Amazonian species.

Aciotis purpurascens (Aubl.) Triana (149). Surinam: frequent, annual, petals white, anthers pink, thickets, low bush bordered by *Montrichardia arborescens,* lower Saramacca River, vicinity Tawa Creek, *23739;* frequent, annual, petals white, anthers pink, openings, wallaba forest, Base Camp (1), Tafelberg Creek, Saramacca River Headwaters, *24108;* infrequent, annual, flowers white, high mixed wallaba forest, south base Table Mountain, *24827;* flowers pink, km. 68, vicinity Sectie O, *25002*. An abundant and widely distributed Amazonian species. The Guianas, Amazonian Brazil and Peru.

Nepsera aquatica (Aubl.) Naud. (150). Surinam: petals white, anthers purple, along railroad, near km. 70, *23633;* annual, petals white, stamens purple, opening south Savanna IV, Tafelberg, *24387;* infrequent, petals white, stamens purple, moist shaded rocky areas, 3 km. southeast Savanna I, Tafelberg, *24414*. Very abundant in northern South America, especially in open waste places.

Comolia vernicosa (Benth.) Triana (151). British Guiana: infrequent, shrub to 1 m. high, leaves brittle, leathery, glaucous beneath, young fruit yellow-brown, in crevices bed rock, Kaieteur Savanna, *23101;* savanna, Demerara River, *F.D. 504*. Surinam: shrub to 80 cm. high, flowers purple, grass savanna, Zanderij II, *23655*. British Guiana and Surinam.

Comolia lythrarioides (Steud.) Naud. (151). British Guiana: occasional, perennial suffrutescent herb to 60 cm. high, petals and anthers pink,

filaments white, in crevices bed rock, Kaieteur Savanna, *23120;* Karakara Savanna, *F.D. 540.* SURINAM: subshrub to 50 cm. high, flowers pink, grass savanna, Zanderij II, *23701;* frequent, flowers and stamens pink, wet sand, savanna, Zanderij I, *23736.* Known from British Guiana, Surinam, and Trinidad.

COMOLIA VILLOSA (Aubl.) Triana (151). SURINAM: high bush, base north escarpment, Tafelberg, *24321a;* infrequent, flowers whitish, anthers flushed with pink, low bush, Savanna II, Tafelberg, *24231.* Apparently the first report from Surinam, although previously known from French and British Guiana, extending west to Venezuela. The species is distinguished from *C. purpurea* by its glandular pubescence; from *C. veronicaefolia* by its petiole a third to half as long as the blade and the blades rounded at base.

COMOLIA VERONICAEFOLIA Benth. (151). SURINAM: frequent, subshrub to 0.5 m. high, flowers light purple, anthers purple, sandbanks along railroad bed, Kwakoegron, *23778.* Northern Brazil to Trinidad.

COMOLIA ANGUSTIFOLIA Gleason (151). BRITISH GUIANA: occasional, annual tufted herb to 30 cm. high, petals pale mauve, on white sand in secondary forest, Amatuk Portage, Potaro River Gorge, *23022.* Kaieteur Savanna, endemic.

ACISANTHERA TETRAPTERA (Cogn.) Gleason. SURINAM: flowers purple, Zanderij II, *25033.* Endemic and rarely collected.

TIBOUCHINA ASPERA Aubl. (155). SURINAM: shrub to 1 m. high, flowers purple-rose, grass savanna, Zanderij II, *23656;* frequent, subshrub to 0.5 m. high, flowers light purple, anthers white, sandbanks along railroad bed, Kwakoegron, *23777.* Widely distributed in South America, especially in savannas.

PTEROLEPIS GLOMERATA (Rottb.) Miq. (157). SURINAM: petals white, anthers purple, processes yellow, km. 68, vicinity Sectie O, *24988;* annual, petals white, anthers purplish, processes yellow, grass-sedge savannas, Zanderij II, *25038.* A common weedy species of wide distribution in South America and the West Indies.

MACAIREA ASPERA N. E. Brown (158). BRITISH GUIANA: common, shrub of lax growth to 2 m. high, stems quadrangular, pubescence bronze-brown, petals white, suffused with pink beneath, stamens yellow, dominant shrub of bush islands, Kaieteur Savanna, *23110.* Endemic, known only on Roraima and the Kaieteur Plateau.

MACAIREA PACHYPHYLLA Benth. (158). BRITISH GUIANA: common, lax, open-crowned, rounded shrub, leaves bullate, Kaieteur Savanna *23342.* SURINAM: tree 10 m. tall, 10 cm. diameter, leaves glutinous, petals pink-purple, anthers greenish-yellow, filaments purplish, low wet bush, 1.5 km. south of Savanna I, Tafelberg, *24350;* infrequent shrub or small tree to 8 m., flowers deep pink, Savanna IV, Tafelberg, *24793.* Hitherto known only from the plateaus adjacent to Mount Roraima.

The genus is best developed in the Pacaraima Mountains and a few species extend east to the Kaieteur Plateau. In the key to the genera of Tibouchineae in the Flora of Surinam, it would be referred to *Tibouchina* or *Pterolepis.* It differs from the Surinam representatives of these genera in the pubescence of the hypanthium, which includes neither branched hairs nor flat scales.

DESMOCELIS VILLOSA (Aubl.) Naud. (158). SURINAM: annual, petals pink, stamens pale, grass-sedge savanna, Zanderij II, *25040*. A widely distributed weedy plant extending south to southern Brazil.

TRIBE VII. MICONIEAE

BELLUCIA GROSSULARIOIDES (L.) Triana (160). SURINAM: tree 18 m. tall, 40 cm. diameter, flowers white, fruit yellowish, edible, tree non-buttressed, rear of village, Pakka Pakka, Saramacca River, *23968;* occasional, tree to 5 m. high, 7 cm. diameter, flowers pink in bud, edge of forest, sandbanks along railroad bed, Kwakoegron, *23785*. Widely distributed through northern South America, extending also north into Central America.

LOREYA MESPILOIDES Miq. (161). BRITISH GUIANA: low tree to 4 m. high, 3 cm. diameter, cauliflorous, leaves rough, rocky lateritic soil, Garraway Stream, Potaro River, *22967*. Probably throughout forested region of British Guiana; Surinam, French Guiana; reported from Peru.

HENRIETTELLA CAUDATA Gleason. BRITISH GUIANA: infrequent small tree to 5 m. tall, 4 cm. diameter, cauliflorous, flowers greenish, fruit bright red, mixed forest, Kamuni Creek, Groete Creek, Essequibo Creek, *22907*. SURINAM: rare, base talus, north slopes, Tafelberg, mixed forest, *25067;* infrequent, small tree, fruit red, mixed high wallaba forest, km. 25, south base Tafelberg, *24821*. British Guiana and Surinam. Known to me hitherto only from the type collection in Surinam.

It may be distinguished from *H. verrucosa* by its glabrous leaves and from *H. flavescens* by its narrow, caudate-acuminate leaves.

Henriettella venosa Gleason, sp. nov. Rami juveniles densissime fulvo-pubescentes mox glabrescentes. Petioli 2–5 cm. longi sicut rami pubescentes. Laminae ovatae usque ad 18 cm. longae 9 cm. latae, acuminatae, basi cuneatae, insigniter 5–7-pli-nerviae, supra glabrae, subtus ad paginam glabrae ad venas venulasque furfuraceae. Flores 4-meri sessiles, pauci in fasciculo ad axillas foliorum delapsorum. Hypanthium campanulatum 2 mm. longum; sepala lata triangularia, a sinibus 0.3 mm. longa; dentes exteriores crasse subulati, patuli, valde recurvi, circa 1.5 mm. longi. Petala triangularia acuta, ca. 2 mm. longa. Stamina 8 isomorpha; filamenta nondum evoluta; antherae lineares 1.7 mm. longae, poro dorso-terminali dehiscentes.

TYPE: occasional, shrub to 3 m. high, cauliflorous, *Mora* and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, British Guiana, April 14, 1944, *Maguire & Fanshawe, 22833*. New York Botanical Garden.

About 40 species of *Henriettella* have been described. Several of them have strongly pli-nerved leaves, like our species, but among them are none which combine the characters of sessile 4-merous flowers and large exterior teeth.

HENRIETTEA MULTIFLORA Naud. (162). BRITISH GUIANA: occasional to frequent, small tree to 4 m. high, 3 cm. diameter, cauliflorous, petals and filaments white, anthers purple, on white sand, secondary forest, Waratuk Falls, Potaro River Gorge, *23041*. Forested regions, French Guiana to Trinidad.

HENRIETTEA MARONIENSIS Sagot. SURINAM: shrub 3 m. tall, savanna, east side, Zanderij I, *25047*. Hitherto known only from French Guiana. It has a hairy style, as does *H. succosa* (Aubl.) DC., and is separated from that species by the very long hairs of the hypanthium.

Henriettea succosa (Aubl.) DC. (162). British Guiana: frequent, tree to 12 m. tall, 10 cm. diameter, fruit urceolate, 10–12 mm. long, 10–12 mm. broad, sweet, edible, openings in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22882*. Probably throughout forested regions, central Brazil to Panama and Trinidad.

Henriettea ramiflora (Sw.) DC. (162). British Guiana: common, tree 6–8 m. tall, 10 cm. diameter, veins and sometimes leaves suffused red on lower surface, cauliflorous, petals pink, anthers blue, filaments pale pink, ripe fruit brown-purple, edible, bush islands on Kaieteur Savanna, *23126*. Surinam to Jamaica.

Leandra purpurea Gleason (163). British Guiana: subshrub to 1.6 m. high, flowers white, fruit magenta-purple, rocky lateritic soil from dolerite dyke, roadside, Garraway Stream, Potaro River, *22986;* dense forests vicinity Bartica, Moraballi Creek, *F1289*. Endemic.

Leandra rufescens (DC.) Cogn. (164). British Guiana: frequent, shrub to 2 m. high, *Mora* forests, Kamuni Creek, Groete Creek, Essequibo River, *22814;* Camana Road, *Aitkin A42*. Surinam: shrub to 3 m. high, stems velvety, tawny to base, swamps in primary jungle, near Posoegronoe, 24045. Kaieteur Falls; eastern Brazil to Venezuela and Trinidad.

Leandra micropetala (Naud.) Cogn. British Guiana: occasional to frequent, lax-branched shrub to 1.5 m. high, flowers white, calyx lobes green, young fruit pink-red, from *Dicymbe* forest, on white sand, trail Tukeit to Kaieteur Plateau, *23064*.

New to British Guiana. The specimens lack flowers, but the foliage and pubescence indicate the species. It is distinguished from *L. rufescens*, to which it would be referred through the key in the Synopsis, by the spreading pubescence of the stem and the permanently setose upper surface of the leaves.

Leandra solenifera (Schrank) DC. (164). British Guiana: rare to occasional, subshrub to 45 cm. high, strongly stoloniferous, inflorescence scorpoid, green, petals white, anthers pink, on white sand, clearing at forest edge, Tukeit, Potaro River, *23042*. Surinam: frequent, shrub to 2 m. high, petals and filaments pale pink, anthers white, swampy bush above Jacob kondre, along Saramacca River, *23871*. Widely distributed but apparently never abundant in the Amazonian forests. Upper Mazaruni River, French Guiana and Amazon Valley.

Leandra divaricata (Naud.) Cogn. (164). British Guiana: probably perennial, stoloniferous, rooting at nodes, floor of openings, damp soil, *Mora* and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22918*. Surinam: common, fruit purple, openings in montane forest, line between Kwatta (3) and Pakira (4) Camps, Coppenam River Headwaters, *24162;* montane forest, vicinity Krappa Camp (2), *24146a*. Abundant in lowland forests in the three Guianas. Lowlands from French Guiana to Venezuela; reported from upper Amazon Valley.

Leandra longicoma Cogn. (164). British Guiana: occasional, shrub 1.3 m. high, lax-branched, inflorescence hairy, brown to crimson, pubescence velvety, petals pink to red, stamens yellow, on white sand, clearing at forest edge, Tukeit, Potaro River Gorge, *23045*. Also in Amazonian Peru, where it is abundant.

Leandra sanguinea Gleason. The type material, collected by Sandwith

on the Kaieteur Plateau, was in fruit. Flowering material collected by Maguire enables me to issue the following supplemental description:

Hypanthium cup-shaped, 2.8 mm. long, densely strigose with erect hairs up to 2 mm. long; sepals 0.5 mm. long from the torus, depressed-ovate; exterior teeth totally adnate, linear, projecting 1.6 mm. beyond the sepals, hirsute like the hypanthium; petals narrowly triangular, acute, 2.3 mm. long; stamens isomorphic; filaments 3 mm. long; anthers linear, obtuse, 1.4 mm. long, opening by a ventral pore; connective neither appendaged nor prolonged; ovary 3-celled, half-inferior, its conic summit 10-toothed, each tooth bearing a minute terminal glandular bristle. BRITISH GUIANA: frequent, shrub to 2 m. high, lax growth, inflorescence with pink hairs, petals white, stamens yellow, rocky places, mixed moutane high forest, trail Tukeit to Kaieteur Plateau, *23075*.

OSSAEA DUCKEANA Hoehne. BRITISH GUIANA: rare, vine from low tree, attached by short rootlets to tree, fruit 10 × 8 mm., blue, fleshy, Kaieteur Savanna, *23228*. The specimen agrees in every way with Hoehne's careful description, plate, and dissections. It represents a new genus for British Guiana and is possibly the second collection of the species.

The genus *Ossaea* is distinguished from *Clidemia* by its acute petals and from *Leandra* by its axillary flower clusters.

CLIDEMIA CAPITATA Benth. (166). BRITISH GUIANA: frequent, lax shrub to 2 m. high, flowers white, in bracteate heads, fruit 1.5 × 1 cm. oblong-globose, deep blue, bush islands, Kaieteur Savanna, *23130*. Otherwise known from the Roraima region.

CLIDEMIA RUBRA (Aubl.) Mart. (166). BRITISH GUIANA: subshrub to 1 m. high, petals pink, fruit globose, purple, on rocky lateritic soil, at edge of clearing, Garraway Stream, Potaro River, *22953*. SURINAM: perennial, petals whitish, anthers bright purple-red, pubescence stramineous becoming brown, grass-sedge savanna, Zanderij II, *25039*. Common almost throughout tropical America.

CLIDEMIA APHANANTHA (Naud.) Sagot. BRITISH GUIANA: frequent, subshrub to 1.3 m. high, leaves purple-tinged below, petals white, fruit purple, on rocky lateritic soil from dolerite dyke, Garraway Stream, Potaro River, *22978*; Mazaruni Station, Mazaruni River, *F1386*. Included under *C. rubra* in the Synopsis, and weakly distinguished from it by the presence of petioles 2–5 cm. long.

CLIDEMIA JAPURENSIS DC. (166). SURINAM: locally common, shrub to 2 m. high, herbage glutinous, petals white, anthers yellowish, fruit 12 mm. long, pale blue, openings in low bush, 1 km. south Savanna I, Tafelberg, *24348*. Widely distributed in the Amazonian forests, British Guiana, Surinam, and Amazon Valley.

CLIDEMIA MINUTIFLORA (Triana) Cogn. (166). BRITISH GUIANA: locally frequent, subshrub to 1 m. high, flowers axillary, white, red loam, rocky ground, trail from Tukeit to Kaiateur Falls, *23068*. SURINAM: subshrub to 5 m. high, opening in high bush, base north escarpment, Tafelberg, *24317*; frequent, subshrub to 1 m., petals white, anthers pale yellow, dense shade, overhanging East Ridge Gorge, high forest, Tafelberg, *24532*. Upper Mazaruni River, also upper Rio Negro. Recognized by its dimorphic leaves essentially glabrous above and glandular-hirsute hypanthium.

CLIDEMIA TILIAEFOLIA DC. (166). SURINAM: frequent, open slender

shrub to 3 m., flowers and anthers white, bush to rear of Jacob kondre, Saramacca River, *23755*. A species of the Amazonian forests.

CLIDEMIA HIRTA (L.) D. Don. (166). BRITISH GUIANA: frequent, weak shrub to 1 m. high, flowers white, fruit globose, blue-black, high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22840;* rocky lateritic soil, clearing edge, Garraway Stream, Potaro River, *22960*. SURINAM: frequent, subshrub 1 m. high, flowers and stamens white, along railroad near km. 70, *23631;* frequent subshrub to 1.5 m. high, fruit blue, thickets, low bush bordered by *Montrichardia arborescens,* lower Saramacca River, vicinity Tawa Creek, *23738;* frequent, annual to 0.5 m., flowers and anthers white, fruit blue, about clearings, Jacob kondre, bush to rear of village, Saramacca River, *23754*. Common and widely distributed almost throughout tropical America.

CLIDEMIA INVOLUCRATA DC. (167). BRITISH GUIANA: occasional, woody shrub to 2 m. high, inflorescence of three flowers, red-purple, fruit pale china blue, pithy, river bank between Kangaruma and Amatuk, Potaro River, *23010*. Upper Demerara River, lower Essequibo River; French Guiana to Trinidad.

CLIDEMIA SILVICOLA Gleason. BRITISH GUIANA: occasional to frequent, tall perennial herb to 1 m. high, flowers white, fruit purple, roadside, Garraway Stream, Potaro River, *22985*. Hitherto known only from the type collection of *A. C. Smith,* British Guiana.

Through the key in the Synopsis this would be referred to *C. coriacea.* Our plant is pubescent with simple hairs, while the pubescence of *C. coriacea* is stellate.

CLIDEMIA PYCNASTER Tutin. BRITISH GUIANA: locally frequent, subshrub 60 cm. high, inflorescence brown, petals white with pink center, filaments pink, anthers white, Kaieteur Savanna, *23311*. SURINAM: frequent slender branched shrub to 1.5 m., petals pale lavender, anthers purple, processes and filaments white, Savanna II, Tafelberg, *24230;* rare, petals pink on midrib and base, stamens whitish, glands purple, border low bush, Savanna IV, *24389;* shrub to 1.5 m., Savanna IX, Tafelberg, *24653*. Hitherto known only from the Kaieteur region of British Guiana.

This species has 4-merous flowers also, and may be distinguished from the other Surinam species by its close stellate-tomentose indument.

CLIDEMIA SEPTUPLINERVIA Cogn. BRITISH GUIANA: cauliflorous, hypanthium pale green, calyx and teeth long, revolute, petals white, ovate, patent, stamens white, fruit globose, china blue, seeds numerous, dark brown, Groete Creek, Essequibo River, *F1720*. Peru, Ecuador, Colombia, Jamaica.

CLIDEMIA UMBONATA DC. (167). BRITISH GUIANA: occasional, shrub to 3 m. high, lax growth, flowers translucent white, young fruit crimson, ripe fruit black, Kaieteur Savanna, *23247;* Mazaruni Station, Mazaruni River, *M351*. Common throughout colony; Amazon Valley to Caribbean Sea.

CLIDEMIA STRIGILLOSA (Sw.) DC. (167). BRITISH GUIANA: rare, shrub of lax growth to 1.3 m. high, pubescence reddish, petals white, Kaieteur Plateau, *23103*. SURINAM: petals pale green, anthers rose, savanna, vicinity Sectie O, *25017;* openings low bush, 1 km. south of Savanna I, Tafelberg, *24348a*. Widely distributed in tropical America.

24348a varies from typical *C. strigillosa* in a number of small differences, but not sufficiently to interpret the collection as a new species.

CLIDEMIA CONGLOMERATA DC. (167). BRITISH GUIANA: frequent shrub to 4 m. high, *Mora* forests, Kamuni Creek, Groete Creek, Essequibo River, *22808;* subshrub to 1 m. high, flowers white, fruit globose-oblong, blue, rocky lateritic soil, clearing edge, Garraway Stream, Potaro River, *22954* French Guiana to Trinidad.

CLIDEMIA sp. BRITISH GUIANA: subshrub to 1 m. high, flowers white, fruit blue-black, on rocky lateritic soil, clearing edge, Garraway Stream, *22958*. While the pedunculate inflorescence with a single central axis shows its affinity with *C. umbonata* and allies, it cannot be referred satisfactorily to a species.

MAIETA POEPPIGII Mart. (168). BRITISH GUIANA: rare, lax-branched subshrub 0.6–1.3 m. high, hairy, hypanthium yellow, fruit glossy black, from red loam on rocky ground, *Dicymbe* forest, Tukeit to Kaieteur Falls, *23060; 23069*. Kangaruma; also throughout Amazon Valley and in Cocos Island.

TOCOCA ARISTATA Benth. (169). BRITISH GUIANA: occasional, shrub to 2 m. high, swollen petioles inhabited by ants, flowers pale yellow, filaments pale yellow, anthers pink, secondary forest, on white sand, Waratuk Falls, Potaro River Gorge, *23034;* Tukeit to Kaieteur, *23063*. Widely distributed throughout colony; French Guiana to upper Amazon Valley.

TOCOCA NITENS (Benth.) Triana (170). BRITISH GUIANA: occasional shrub, 1–1.6 m. high, leaves leathery, thick, petals pink shading to white on margins, anthers white, filaments pink, fruit oblong, blue-black, Kaieteur Savanna, *23177*. Also in southern Venezuela and adjacent Brazil.

TOCOCA DESILIENS Gleason. BRITISH GUIANA: rare, shrub to 4 m. high, 2–3 cm. diameter, open-crowned, petals part pink, part white, calyx truncate, anthers white, filaments pink, from *Terminalia* forest, Kaieteur Savanna, *23293*. Hitherto known only by the tyye collection, *Sandwith 1426;* endemic to British Guiana.

The species is characterized by glabrous style and absence of formicaria. It is separated from three other species with the same character by the long glandular hairs of the hypanthium.

MICONIA ACINODENDRON (L.) Sweet. SURINAM: frequent subshrub to 2 m., flowers white, low bush bordered by *Montrichardia arborescens*, lower Saramacca River, vicinity Tawa Creek, *23745*. Known also from British Guiana and the West Indies.

MICONIA RACEMOSA (Aubl.) DC. (177). BRITISH GUIANA: shrub to 2 m. high, flowers greenish-white, fruit oblong, purple-black, rocky lateritic soil, roadside and clearing edge, Garraway Stream, Potaro River, *22955*. SURINAM: shrub to 3 m., flowers purple, Kwakoegron, *25007*. Widely distributed; West Indies, in South America south to Rio de Janerio.

MICONIA CILIATA (Rich.) DC. (177). BRITISH GUIANA: occasional, shrub to 2 m. high, glabrous, leaves leathery, inflorescence scorpioid, petals pink basally, white apically, anthers purple, fruit black, in white sand, Kaieteur Plateau, *23105*. SURINAM: shrub to 3 m., flowers pink, savanna, Zanderij II, *23658;* frequent, shrub to 2 m., leaves subcoriaceous, dark glossy green, petals deep purple at base, light at tip, low bush, north Savanna III, Tafelberg, *24287;* flowers purple, south savannas, vicinity Arawak village Mata, *24983*. Widely distributed; tropical America, from central Brazil and Peru to Mexico and the West Indies.

MICONIA VIRGULATA Gleason (177). BRITISH GUIANA: occasional, shrub strict, to 2 m. high, leaves glossy, flowers pink-purple and small, fruit 3–4 mm. diameter, globose, blue-black, white sand, secondary forest species, Waratuk Falls, Potaro River Gorge, *23038*. Endemic to British Guiana.

MICONIA MYRIANTHA Benth. (178). BRITISH GUIANA: occasional, tree 6 m. tall, 3 cm. diameter, leaves glaucous below, fruit globose, reddish, secondary wallaba bush, Kaieteur Savanna, *23227*. Common throughout British Guiana.

MICONIA MARGINATA Triana (178).. BRITISH GUIANAS locally common, shrub, lax growth, leathery leaves supple, flowers spicate, white, Kaieteur Savanna, *23231;* frequent shrub to 1.6 m. high, open growth, leaves leathery, flowers and stamens greenish-white, high mixed forest, Tukeit, *23537;* abundant in damp places, wallaba forest, 107 mile, Bartica-Potaro Road, *F1444*. The Upper Amazon Valley; known in British Guiana otherwise only from Tumatumari.

MICONIA CHRYSOPHYLLA (Rich.) Urban (177). BRITISH GUIANA: undergrowth tree 25 feet tall, 2 inches diameter, leaves buff to brown below, flowers white, minute, young fruit pale mealy green, opening in Greenheart forest, Siba Creek, *F689*. In forested region; Bolivia to Puerto Rico.

MICONIA GRATISSIMA Benth. (178). BRITISH GUIANA: occasional, tree to 5 m. high, 8 cm. diameter, undersurface of leaves tawny-tomentose, hypanthium green, flushed reddish, secondary forest species in white sand, Waratuk Falls, Potaro River Gorge, *23037*. Upper Amazon Valley.

MICONIA DODECANDRA (Desr.) Cogn. (178). SURINAM: tree to 10 m. tall, 10 cm. diameter, trunk 4-lobed, leaves tan beneath, petioles and ribs tawny, petals white, pink at base, stamens yellow, filaments turning orange-red in age, hence, flowers of two striking colors in inflorescence, s.e. margins Arrowhead Basin, Tafelberg, *24415;* frequent, tree 10 m. tall, 15 cm. diameter, petals white, stamens yellow, anthers turning red, high bush, south cliffs Arrowhead Basin, Tafelberg, *24457*. A widely distributed species in tropical America, but hitherto not reported from Surinam.

M. dodecandra resembles the well known *M. guianensis* (Aubl.) Cogn. in general appearance and is easily distinguished from that species by its permanently white-tomentose hypanthium.

MICONIA LONGIFOLIA (Aubl.) DC. (178). SURINAM: frequent, shrub 3 m. high, leaves bright green, fruit red turning blue-black, Jacob kondre, below rapids, Saramacca River, *23844*. Widely distributed from West Indies to Bolivia.

MICONIA PUBIPETALA Miq. SURINAM: small tree 4 m. tall, leaves green above, pink-tan beneath, shoots same color, petals white, pink-flushed, yellowish at base, stamens bright yellow turning red in age, inner surface of calyx red, young fruit red, river banks to Toekoemoetoe Creek, Saramacca River, *24061*. Abundant in the Guianas and Trinidad.

MICONIA SERRULATA (DC.) Naud. SURINAM: small tree to 4 m., petals and filaments white, anthers deep purple, along railroad near km. 70, *23641;* frequent, leaves pink-tan beneath; twigs green-tawny, Jacob kondre, below rapids, Saramacca River, *23843*. Abundant from Mexico and the West Indies to southern Brazil.

MICONIA DIAPHANEA Gleason. SURINAM: frequent, shrub 4 m. high, petals white, anthers yellow, montane forest, along stream-course, line be-

yond Pakira Camp (4), Coppenam River Headwaters, *24163;* infrequent, shrub to 4 m., fruit blue-black, base north escarpment, Tafelberg, *24777*. Endemic.

MICONIA DISPARILIS (Standl.) Williams. BRITISH GUIANA: shrub to 3 m. high in *Mora* bush, Kamuni Creek, Groete Creek, Essequibo River, *22813; F1983*. SURINAM: shrub to 3 m., twigs red, leaves bright glossy green, red-veined beneath, petals and anthers white, openings in wallaba forest, vicinity Base Camp (1), Saramacca River Headwaters, Tafelberg Creek, *24109*. Known also from scattered localities west to Central America; British Guiana, Trinidad.

The species is still poorly known and of remarkably disjunct distribution. Through the key in the Synopsis, it would be referred to the group including species 13–17. It differs from all of these in its 4-merous flowers.

MICONIA ERIODONTA DC. SURINAM: frequent small tree to 4 or 5 m. high, openings in swampy bush above Jacob kondre, Saramacca River, *23872*. Surinam to Pará.

MICONIA BRACTEATA DC. (179). BRITISH GUIANA: shrub to 2 m. high, flowers yellowish, Garraway Stream, Potaro River, *22963*. Peru to the Guianas.

There is every reason to believe that this collection represents the first record of the species in British Guiana. The collections cited under this name in the Synopsis (179) are of a different species, described below. It may be distinguished from *M. bracteata* by its basally attached filaments and much shorter calyx-lobes. In *M. bracteata* the calyx lobes are about twice as long as wide and the filaments are ventrally attached, as in the well known *M. nervosa*.

Miconia demerarensis Gleason, sp. nov. Sect. *Eumiconia Glomeratiflorae*. "*Miconia bracteata*" Gl. Syn. 179, non Triana. Frutex usque ad 2 m. altus; rami dense hirsuti, pilis minutissime plumosis. Petioli validi, 1–2 cm. longi, densissime hirsuti. Laminae ovatae vel ovato-oblongae, 10–18 cm. longae, 5–9 cm. latae, abrupte acuminatae, basi late acutae vel rotundatae, 5-nerviae, utrinque sparse hirsutae, ad venas primarias supra densissime hirsutae; venae secundariae 4–6 mm. dissitae, sub angulo ca. 80° divergentes. Inflorescentia fere decimetralis, a basi trichotoma; rami laterales glomerulos 2 gerentes, terminalis glomerulos 2 sessiles et saepe autem 2 breviter pedunculatos. Flores 5-meri, sessiles, dense fasciculati, bracteis ovatis 3–5 mm. longis, ciliatis intermixtis. Hypanthium campanulatum, 2.5–3.5 mm. longum, dense hirsutum, pilis adscendentibus. Calycis tubus hirsutus breviter productus; sepala ovato-oblonga obtusa, 1–1.5 mm. longa, hirsuta; dentes exteriores patuli subulati. Petala alba, oblonga, 4–5 mm. longa. Stamina isomorpha; filamenta arcuata, 2.5–3 mm. longa, antherae lineares, leviter curvatae, 2.8–3.9 mm. longae, connectivum basi incrassatum, infra thecas 0.5 mm. productum, simplex. Ovarium semi-liberum pilosum; stylus rectus, 6–7 mm. longus; stigma punctiforme. Bacca caerulea subglabra.

TYPE: collected at Groete Creek, Essequibo River, British Guiana, *Fanshawe 4464*. BRITISH GUIANA: Groete Creek, Essequibo River, *F4459;* Mazaruni Station, Mazaruni River, *F4144;* Mora-Balli Creek, Essequibo River, *F4058*. SURINAM: infrequent, subshrub overhanging stream, mixed high forest, North Ridge Cascade, Tafelberg, *24668*. Reported in the Flora of Surinam as *M. bracteata* (DC.) Triana.

MICONIA SILICICOLA Gleason (179). BRITISH GUIANA: Siba Creek, *F685*. Mount Duida, Mount Roraima, Venezuela.

MICONIA CAMPESTRIS (Benth.) Triana (179). BRITISH GUIANA: locally frequent, subshrub 1 to 2 m. high, ripe fruit black, from inundated land, Potaro River above Kaieteur Falls, *23346*. Valley of Upper Amazon River.

MICONIA PLUKENETII Naud. (179). BRITISH GUIANA: tree to 10 m. high, 12 cm. diameter, banks and swamps along Kamuni Creek, Groete Creek, Essequibo River, *22945*. Throughout the colony; French Guiana, Surinam, Trinidad.

MICONIA CERAMICARPA (DC.) Cogn. (180). BRITISH GUIANA: shrub in heavy *Mora* forest, dense second growth in windfall opening, Kamuni Creek, Groete Creek, Essequibo River, *22865a*. Common through forests of British Guiana; the Amazon Valley and the Guianas.

MICONIA POLITA Gleason (180). BRITISH GUIANA: occasional, subshrub to 2 m. high, leaves brittle, fruit pale china blue, pithy, drop at touch, river bank between Kangaruma and Amatuk, Potaro River, *23011*. Endemic.

MICONIA PTEROPODA Benth. (181). BRITISH GUIANA: Kuruabo Falls, Essequibo River, *F1709*. Northern South America.

MICONIA IBAGUENSIS (Bonpl.) Tr. BRITISH GUIANA: pubescent yellow-green shrub, flowers yellow-green, Mazaruni Station, Mazaruni River, *F.D. 114*.

MICONIA PRASINA (Sw.) DC. (181). BRITISH GUIANA: occasional tree 4–5 m. high, 5–8 cm. diameter, fruit globose, deep blue, secondary forest, white sand, mixed forest, Tukeit, Potaro River Gorge, *23053*; Potaro River below Tukeit, *23497*. Common throughout the colony; widely distributed throughout tropical America.

Miconia Maguirei Gleason, sp. nov. Sect. *Eumiconia, Paniculares*. Frutex 1–2 m. altus. Rami dense hirsuti, pilis ferrugineis usque ad 1 cm. longis, petioli 5–12 mm. longi, dense longeque hirsuti. Laminae chartaceae, obovato-ellipticae, 12–18 cm. longae, 6–9 cm. latae, abrupte acuminatae, obcrenato-denticulatae, basi cuneatae, 5-nerviae, jugo exteriori submarginali, supra et subtus ad paginam sparse hirsutae, pilis 3–4 mm. longis, subtus ad venas primarias densius longiusque hirsuti. Panicula in anthesi 3–5 cm. longa, ad nodos longe hirsuta, ad internodos densissime pubescens, pilis adscendentibus 0.4 mm. longis; bracteae oblongae ca. 1 mm. longae. Flores 5-meri brevissime pedicellati. Hypanthium tubulosum, 3.5 mm. longum, sparse hirsutum, pilis simplicibus vel glandulosis usque ad 1 mm. longis, atque minute adpresso-pubescens. Sepala triangularia, ca. 0.7 mm. longa sicut hypanthium pubescentia; dentes exteriores adnati, conici, sepala subaequantes. Petala alba, ovato-oblonga, 2.8 mm. longa. Stamina isomorpha; filamenta jam non evoluta; antherae lineares, 2.9 mm. longae, poro ventro-terminali dehiscentes; connectivum simplex. Ovarium semi-inferum, 3-loculare, glabrum. Fructus (ex no. 23513) globosus valde 10-costatus.

TYPE: shrub 1–2 m. high, lax growth, flowers white, wallaba forest, Kaieteur Savanna, British Guiana, May 11, 1944, *Maguire & Fanshawe 23401*. New York Botanical Garden. BRITISH GUIANA: infrequent, trail Tukeit to Kaieteur Plateau, mixed forest, *23513*. The species is obviously related to those numbered 196 to 200 in Cogniaux's Monograph, of which only ***M. tschudyoides*** Cogn. (***M. robusta***) is known to occur in British Guiana, but differs from all of them in pubescence and especially in its unappendaged connectives.

MICONIA TOMENTOSA (L. C. Rich.) Don (179). SURINAM: shrub to 2 m.

high, petals pale pink, filaments purple, anthers pink, savanna, vicinity Sectie O, *25018*. Widely distributed in the Amazonian region, south to Bolivia and Rio de Janeiro, also in Cuba.

MICONIA spp. SURINAM: tree 10 m. tall, 8 cm. diameter, bark papery, fruit yellow, swampy bush, rear of Kwatta hede, Saramacca River, *23920;* leaves dark green above, light below, coriaceous, fruit blue, river banks above Kwatta hede, Saramacca River, *23936* (flowers lacking); small tree to 5 m., leaves and shoots clear green, fruit apparently yellow at maturity, along Toekoemoetoe Creek, about 3 km. below Base Camp, Saramacca River Headwaters, *24087* (flowers lacking, possibly a member of Sect. *Jucunda*); infrequent, shrub to 3 m., flowers lacking, overhanging East Ridge Gorge, high forest, Tafelberg, *24533* [obviously related to *M. disparilis* (Standley) R. O. Williams, but with 5-merous flowers and distinctly 5-pli-nerved leaves —I am reluctant to segregate it specifically without first seeing the stamens]; frequent small slender tree or shrub, 5 m. high, 6 cm. diameter, pubescence tawny, mixed high forest, below cliffs of west escarpment, Tafelberg, *24689* (flowers lacking, possibly a member of Sect. *Tamonea*); small tree overchanging Tafelberg Creek, Saramacca River Headwaters, *24906* (flowers lacking, possibly a member of Sect. *Eumiconia*, in general habit and pubescence it suggests *M. tschudyoides* Cogn.); frequent slender small tree to 5 m., mixed high bush, not seen flowering, *24654* (sterile, genus unknown, foliage suggestive of *Ossaea*).

APOCYNACEAE[102]

ALLAMANDA CATHARTICA L. SURINAM: frequent, arching scandent subshrub, flowers yellow, rather open savanna bush to 30 m. high, along railroad, vicinity km. 70, Sectie O, *23634;* common, scandent subshrub, flowers yellow, thickets and on trees, sandbanks along railroad bed, Kwakoegron, *23786*.

AMBELANIA ACIDA Aubl. BRITISH GUIANA: undergrowth tree 30 feet tall, 4 inches diameter, milk thick, leaves leathery, flowers white, fruit ovoid, grooved, yellow when ripe, seeds flattened, oblong, brown, in mixed forest, Mazaruni Station, Mazaruni River, *F529*.

ASPIDOSPERMA OBLONGUM A. DC. BRITISH GUIANA: tree 110 feet high, 24 inches diameter, entire trunk to upper limbs deeply fluted, latex copious, Kamuni Creek, Groete Creek, Essequibo River, *22832*. Northern Brazil, British Guiana, Surinam.

ASPIDOSPERMA DESMANTHUM Benth. BRITISH GUIANA: 90-foot tree, 16 inches diameter, leaves stiff, leathery, flowers in terminal corymbose inflorescence, mealy gray, inflorescence wooly, sandhills, wallaba forest, Demerara River, *F1226*. Guiana, northern Brazil.

CONDYLOCARPON MYRTIFOLIUM (Miq.) Muell.-Agr. BRITISH GUIANA: infrequent vine, flowers yellow, latex copious, clearings, high forest, Kamuni Creek, Groete Creek, Essequibo River, *22890;* vine with copious white latex from *Pterocarpus* tree, leaves supple, leathery, glossy, fruit terminal, paired, flattened elongated, yellow-brown, deeply segmented almost like beads on a string, pendent, seed stony, along river, Baramanni Creek, Waini River, N. W. D., *F2330;* 2 cm. diameter gray milky rope from a small *Toulicia*,

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leaves leathery, glossy, flowers in terminal umbellate inflorescence, creamy yellow, tubular, lobes apiculate, flowers wither very quickly, become orange, fruit pendent like beads on a string, individual drupes green, flat oval, Mabaruma, Aruka River, N. W. D., *F2457;* Waipi Creek, lower Mazaruni River, *F1410*. Guianas, northern Brazil, eastern Bolivia.

COUMA RIGIDA Muell.-Arg. BRITISH GUIANA: infrequent, tree 10–12 m. tall, 25 cm. diameter, copious white latex, fruit subglobose, green, not quite ripe, seeds flat, oval, testa brown, from bush island, Kaieteur Savanna, *23232*. Northeastern Brazil, Guianas.

FORSTERONIA n. sp. ? BRITISH GUIANA: rare vine, young fruit angled, green, Kaieteur Savanna, *23254*. The peculiar 4-angled follicles are quite unlike anything in *Forsteronia* known to me. Flowers are necessary for identification.

FORSTERONIA sp. BRITISH GUIANA: 6 cm. diameter soft black-brown rope with copious white sticky latex, from crown of a small *Ocotea,* leaves soft, wooly beneath, the hairs stellate, fruit terminal, bilobed, the two lobes spreading at an obtuse angle from each other, somewhat triangular, green, Groete Creek, lower Essequibo River, *F1996*. Mr. Krukoff has collected this species in Amazonian Brazil upon several occasions, but always in fruit, so I am unable to describe the species which apparently is new. The leaves strikingly resemble those of *F. spicata,* but the follicles are very distinct.

FORSTERONIA GRACILIS (Benth.) Muell.-Arg. BRITISH GUIANA: 2–3 cm. diameter gray-black, stiffly pliable rope from crown of a *Mora* in *Mora* forest, leaves thinly leathery, glossy, flowers in axillary elongated bifurcate inflorescences, creamy white, plentiful thin, white, watery latex, Kauria Creek, lower Cuyuni River, *F1418;* 3 cm. brown scaly rope from crown of a greenheart in mixed forest, also common on *Mora* trees, thin white latex present in all parts, leaves leathery, male flowers in short, glaucous green, paired spikes on a long terminal peduncle, fruit on separate peduncles, 2–4 together, pale green, pithy, fleshy, seed conical, creamy, testa bony, Takutu Creek to Puruni River, Mazaruni River, *F2113*. SURINAM: rope, flowers white, latex white, mixed montane high forest, North Ridge, Tafelberg, *24799*. Guiana, northern Brazil.

My specimen of *F2113* bears leaves exactly like those of *F1418,* which is typical flowering *F. gracilis*. In the inflorescence of the former, however, there are two pairs of very young follicles, and in addition four or five objects which resemble the fruits of a *Viburnum*. These I have dissected to no avail, and regard them possibly as galls of some sort. I suppose these are the objects that led Mr. Fanshawe to interpret the flowers as dioecious.

GEISSASPERMUM SERICEUM (Sagot) Benth. BRITISH GUIANA: tree over 100 feet high, 20 inches diameter, bark furrowed, bole fluted, flowers whitish within, corolla lobes without have silky brown indumentum, leaves whitish below, mixed forest, Malali Rapid, Demerara River, 85 miles south of Georgetown, *D449*.

HIMATANTHUS ARTICULATA (Vahl) Woods. BRITISH GUIANA: tree 50 feet tall, 12 inches diameter, thick milk, unbuttressed, leaves in dense whorls at tips of branches, leathery, thick, flowers white, tubular, in articulate cymes, buds long and narrow, Mazaruni Station, Mazaruni River, *F643*. SURINAM: small tree, south savanna, vicinity Arawak village of Mata, Zanderij I, *24964*.

HIMATANTHUS BRACTEATA (A. DC.) Woods. BRITISH GUIANA: occasional, tree 6–8 m. high, 10 cm. diameter, latex white, copious, fruit of 2 follicles, pendent, glossy green, dehiscent at maturity, seeds winged, from bush island, Kaieteur Plateau, *23199*. SURINAM: infrequent, tree to 15 m. tall, 25 cm. diameter, copious white latex from broken petioles, stems, etc. hardening into tough gum with properties of chicle, flowers white, associated with galata, streamside, North Ridge Cascade, Tafelberg, *24667*. Northern Brazil, British Guiana, Surinam.

MACROPHARYNX SPECTABILIS (Stadelm.) Woods. BRITISH GUIANA: 2 cm. rope, leaves paired, fleshy, flowers tubular, white, in axils, pendent, shortly stalked, calyx lobes ciliate, linear-lanceolate, corolla of 2 urn-shaped portions, wallaba forest, Moraballi Creek, Essequibo River, *F1299;* sandhills, Demerara River, *F1196*.

MALOUETIA TAMAQUARINA (Aubl.) A. DC. BRITISH GUIANA: small tree, 5 m. high, to 8 cm. diameter, latex copious, flowers yellow, banks and swamps along Kamuni Creek, Groete Creek, Essequibo River, *22926; F1732;* small riparian undergrowth tree of lax growth with white latex, leaves supple, leathery, inflorescence axillary, of many paired flowers on long stalks, all parts varnished, buds yellowish with red gloss, convolute, corolla lobes hooded, pale yellow on upper part, brownish on lower, fruit paired, cylindrical, green, when ripe brown to black, dehiscent, Baramanni Creek, Waini River, N. W. D., *F2331*. Guianas, northern Brazil.

MALOUETIA SCHOMBURGKI Muell.-Arg. BRITISH GUIANA: lax shrub or small tree 8 feet tall, grows to 20 feet and 3 inches diameter, white latex, leaves supple, thinly leathery, flowers axillary, long-stalked, many-rayed from a very short peduncle, calyx green, lobes spreading to revolute, corolla tube greenish, glabrous, corolla lobes reflexed, white with a greenish tinge, partly twisted, with revolute margins and erect white hairs on upper surface, staminal cone extruded, from *Euterpe* swamp, Baramanni Creek, Waini River, N. W. D., *F2336*. British Guiana.

MANDEVILLA SUBSPICATA (Vahl) Mgf. SURINAM: frequent, vine, flowers yellow, orange-striped throat, rather open savanna bush 30 m. high, Sectie O, vicinity km. 70, along railroad, *23614;* km. 68, vicinity Sectie O, *24994;* vine, flowers yellow, Savanna III, Tafelberg, *24269;* frequent, east escarpment, Tafelberg, *24560*. Venezuela, Guianas.

MANDEVILLA BENTHAMII (A. DC.) K. Sch. BRITISH GUIANA: frequent, perennial with subfleshy stems, leaves glaucous below, flowers orange-yellow, suffused with red on narrow part, glossy, young fruit crimson, in moist sand, Kaieteur Plateau, *23128*. Known only from the Kaieteur Plateau.

MANDIVILLA VANHEURCKII (Muell.-Arg.) Mgf. BRITISH GUIANA: vine climbing to 6 m., leaf margins and midrib red, flowers rich yellow, narrow portions of tube crimson, glossy, young fruit crimson, Kaieteur Savanna, *23170*. I have previously cited this species only from Amazonian Peru; and in the Pacaraima Mountains I should expect to find *M. subcarnosa* (Benth.) Woods. instead of the Peruvian species. The leaves of *23170*, however, correspond much more closely with those of *M. Vanheurckii*.

MANDEVILLA sp. SURINAM: vine, corolla yellow, orange-red in throat, savanna, Sectie O, km. 68, *25024*.

MESCHITES TRIFIDA (Jacq.) Muell.-Arg. SURINAM: frequent, vine, flower tube pink, throat cream, follicles connate at tip only, along Saramacca River, vicinity Brokolonka, *23791*.

ODONTADENIA GRANDIFLORA (G. Mey.) Miq. BRITISH GUIANA: hard rope, on tree, milk copious, leaves stiff, flowers in axillary panicles, tubular, calyx yellow, corolla salmon-pink, striped scarlet on tube, stamens in a ring, in swamps, Kaow Island, Essequibo River, *F773;* Essequibo River by Yakamore Creek, *F1357.* SURINAM: frequent ornamental vine, corolla throat striately orange-red within lobes shading to delicate orange-pink, fragrant, river bank, vicinity Saron Creek, Saramacca River, *23771.*

ODONTADENIA NITIDA (Vahl) Muell.-Arg. BRITISH GUIANA: milky vine from low bushy vegetation along creek, leaves thinly leathery, flowers tubular, cream-yellow, calyx glossy, young fruit paired, flat, cylindrical, green, Koboremo Creek, Aruka River, N. W. D., *F2516.* Trinidad to Peru.

ODONTADENIA PUNCTICULOSA (A. Rich.) Pulle. BRITISH GUIANA: soft black rope, copious latex, leaves coriaceous, flowers in axillary panicles, buds glabrous, calyx downy, flowers tubular, yellow lobes convolute, spreading tube contracted ½ inch above calyx, Winiperu Creek, miscellaneous forest, *F302.*

Parahancornia tabernaemontana Woodson, sp. nov. Arbor ca. 15 m. alta, ramulis dichotomis glabris. Folia opposita usque 2 cm. petiolata glabra, lamina late elliptica nisi obovato-elliptica firmiter membranacea apice obtusa basi late acuta 10–13 cm. longa 5.5–8.0 cm. lata glabra. Inflorescentia terminalis thyrsiformis multiflora 3.5–4.0 cm. pedunculata glabra vel indistincte papillata. Flores mediocres albi, pedicellis ca. 0.5 cm. longis. Calycis laciniae 5, quadrato-orbiculares intus minute squamelligeres extus minute papillatae. Corollae hypocrateriformes tubo ca. 0.5 cm. longo basi ca. 0.15 cm. diam. extus glabro intus tomentoso sub medio staminigero lobis anguste oblongo-ellipticis ca. 0.8 cm. longis sparse ciliolatis. Antherae ca. 0.3 cm. longae. Ovarium truncate conicum 2-loculare ca. 0.15 cm. altum apice puberulo-papillatum, stigmate conico-umbraculiformi anguste 2-apiculato ca. 0.2 cm. longo. Fructus ignotus.

TYPE: high mixed forest, east slope of Hill I, Tafelberg, Surinam, September 13, 1944, *Maguire 24719.* Missouri Botanical Garden; New York Botanical Garden.

Outstanding in the genus as known at present because of its large, membranaceous leaves, pentamerous calyx with internal squamellae, large anthers, and completely 2-celled ovary, all of which probably may be interpreted as "primitive" characters. Dr. Maguire notes the presence of copious white latex.

PRESTONIA ACUTIFOLIA (Benth.) K. Sch. SURINAM: frequent, vine, flower tube yellow, throat white, follicles connate for entire length, vicinity Brokolonka, Saramacca River, *23790.*

PRESTONIA SURINAMENSIS Muell.-Arg. BRITISH GUIANA: vine from bushy growth, all parts bristly, hair brown, leaves herbaceous, inflorescence axillary, oblong-capitate, flowers yellow, tubular, rotate, subtended by lanceolate bracts, anthers arching inwards to block throat, Takutu Creek to Puruni River, Mazaruni River, *F2010.* Guianas, northern Brazil.

PRESTONIA MARGINATA (Benth.) Woods. BRITISH GUIANA: vine, on *Myrcia,* leaves leathery, flowers in axillary fascicles, pedicels white, calyx pale pink, tube yellow, Takutu Creek to Puruni River, Mazaruni River, on rocks in falls, *F2138.*

PRESTONIA PERPLEXA Woods. BRITISH GUIANA: occasional, vine with

milky latex, flowers pale yellow, lobes reflexed, tube partly crimson, calyx crimson, young fruit crimson, riverside, Potaro River, above Kaieteur Falls, *23351*. This appropriately named species has been known to me previously only from a specimen without data, collected by Lund in Brazil and deposited in the herbarium at Copenhagen. It is gratifying to have a second, fully documented specimen.

RHABDADENIA BIFLORA (Jacq.) Muell.-Arg. SURINAM: frequent perennial to 1 m. high, flowers white, in drier marsh areas, road to Carl François along Saramacca River, km. 79 from Paramaribo, *23596*.

Stemmadenia cerea Woodson, sp. nov. Arbuscula 6 m. altitudine attingens. Ramuli glabri graciles lignosi divaricate compositi. Folia opposita glabra firmiter membranacea supra saturate subtus dilute viridia; petiolo 0.5–0.7 cm. longo; lamina oblongo-elliptica apice longiuscule subcaudato-acuminata basi obtusa in petiolo sensim attenuata 6.5–8.0 (usque 12.0 ?) cm. longa medio 2.0–3.0 (usque 6.0 ?) cm. lata. Inflorescentiae pauci- vel 1-florae terminales vel pseudo-axillares; pedunculo ad 1.5 cm. longo vel subnullo; pedicellis ca. 1 cm. longis glabris. Calycis laciniae aliquantum inaequales erectae basi imbricatae plus minusve petalaceae ut videntur haud foliaceae glabrae ovato-oblongae valde obtusae 0.8–1.0 cm. longae intus basi multi-squamelligerae. Corollae hypocrateriformes albidae cereae tubo 3.0–3.2 cm. longo basi ca. 0.4 cm. diam. dein sensim angustato tertia parte superiori staminigero ibique ca. 0.15 cm. diam. deinde in faucibus cylindrato-conicis dilatato ostio ca. 0.5 cm. diam. lobis patento-patulis late elliptico-dolabriformibus ca. 0.5 cm. longis. Antherae sessiles triangulari-sagittatae acuminatae basi rigide 2-dentatae ca. 0.5 cm. longae glabrae. Carpella glabra oblongo-ovoidea ca. 0.3 cm. alta apocarpa nectario ½ altitudinis omnino adnato vix bene manifesto. Folliculi immaturi oblique ellipsoidei vex apiculati 3 cm. longi ca. 1 cm. diam.

TYPE: tree 6 m. high, corolla lobes cream-white, dense forest, 700 m. altitude, northwestern portion of Kanuku Mountains, Mount Iramaikpang, British Guiana, April 22–23, 1938. *A. C. Smith 3606*. Missouri Botanical Garden. COTYPE: occasional shrub to 3 m. high, latex copious, white, flowers reflexed, white, waxen, from *Dicymbe* forest, Tukeit, British Guiana, May 18, 1944, *Maguire & Fanshawe 23536*.

The type specimen, sent me for determination some years ago, was not immediately recognized as a *Stemmadenia* because its general aspect is rather more suggestive of such Tabernaemontanas as *T. flavicans*, in spite of the over-sized calyx. Stemmadenias usually are readily distinguishable from other Tabernaemontanoideae by means of the epistaminal ridges within the corolla tube. These vary considerably amongst the various species, but in *S. cerea* they are not apparent in my dissection. The wholly adnate nectary (discus) and lack of definite contortion of the corolla throat also are novelties in the genus, and probably indicate *S. cerea* as a distinctly "advanced" species. Similar petalaceous calyx lobes, however, occur in such Central American congeners as *S. lagunae,* and the structure of the anthers, calycine squamellae, ovary, and petiolar rings all are quite characteristic of *Stemmadenia.*

It should be noted that the Maguire and Fanshawe number, my duplicate of which bears a single small flower bud, differs from that of Dr. Smith in having conspicuously larger leaves as indicated by the parenthetic

measurements in my description. The two collections come from geographically distinct regions. Present evidence, however, certainly does not warrant specific distinction.

STEMMADENIA GRANDIFLORA (Jacq.) Miers. SURINAM: frequent, shrub to 3 m. tall, flowers yellow, about thickets, coastal jungle, road to Carl Francois along Saramacca River, km. 40 from Paramaribo, *23585*. Widely distributed from southern Mexico to northern Brazil. My duplicate is accompanied by a single detached, damaged flower, and the determination cannot be made without qualification.

TABERNAEMONTANA ALBESCENS Rusby. BRITISH GUIANA: shrub with copious white latex, flowers waxen white, solitary or 2–3, calyx adpressed to corolla tube, corolla lobes convolute, reflexed, fruit bilobed, flattened, ovoid, in mixed forest, Mahdia River-Potaro River, Bartica-Potaro Road, *F993*.

TABERNAEMONTANA ALBIFLORA (Miq.) Pulle. BRITISH GUIANA: shrub 4–6 feet high, leaves leathery, flowers white, tubular, corolla lobes reflexed, Marbaruma, Aruka River, N. W. D., *F2358*. SURINAM: frequent, small tree to 3 m. high, flowers white, vicinity Krappa Camp (2), km. 3.5, Saramacca River Headwaters, *24888;* flowers white, border of woods, Grasi Falls, Saramacca River, *24943*. Known from British Guiana, Surinam, and French Guiana.

TABERNAEMONTANA ATTENUATA (Miers) Urb. SURINAM: frequent, small tree, flower lobes yellow, outside throat white, tube pink, montane forest, vicinity Krappa Camp (2), Saramacca River Headwaters, *24139;* frequent, small tree, flower tube pink, lobes yellow, steep slopes, Tafelberg, *24540*. Guianas, northern Brazil, Trinidad.

TABERNAEMONTANA HETEROPHYLLA Vahl. BRITISH GUIANA: frequent, shrub to 2 m. high, in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22904*. SURINAM: shrub to 3 m. tall, dichotomously branched, milky latex, flowers white, in the branch forks, frequent, dense secondary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22745*. Guianas, northern Brazil.

TABERNAEMONTANA TETRASTACHYA HBK. BRITISH GUIANA: weak shrub or scrambler with lower stems arching about the ground and shoots to 12 feet tall from water-logged sections of river bank, latex white, sticky, leaves paired, thinly leathery, glossy, flowers in axillary inflorescence, buds green, convolute, flowers white, petals reflexed, Takutu Creek to Puruni River, Mazaruni River, *F2158; F2013*. SURINAM: infrequent, flowers white, petals reflexed, leaves coriaceous, corrugated, latex copious, river banks below rapids, Jacob kondre, *23840;* small tree to 6 m., in rather open savanna bush to 30 m. high, Sectie O, along railroad, vicinity km. 70, *23638a*. Guianas, northern Brazil, eastern Bolivia.

TABERNAEMONTANA UNDULATA Vahl. BRITISH GUIANA: small tree 4–5 m. tall, 5 cm. diameter, primary forest and openings, Kamuni Creek, Groete Creek, Essequibo River, *22846*. SURINAM: tube red, lobes white, east side, savanna, Zanderij I, *25057;* small tree to 8 m. tall, in high wallaba forest, km. 18.5, Coppenam River Headwaters, *24828*. Guianas, Trinidad, northern Brazil.

var. ? SURINAM: frequent, small tree 5 m. high, 5 cm. diameter, flowers white, copious latex, pina swamps, vicinity Krappa Camp (2), Saramacca River Headwaters, *24125*.

Tabernaemontana versicolor Woodson, sp. nov. Arbuscula ca. 1 m. alta. Ramuli divaricate compositi glabri maturitate cortice rimoso. Folia opposita subsessilia coriacea glabra penninervia anguste elliptico-lanceolata basi subcuneata apice longiuscule subcaudato-acuminata 7–10 cm. longa medio 2.0–2.3 cm. lata. Inflorescentiae dichasiales pauciflorae terminales vel pseudoaxillares; pedunculus bifurcatus ca. 0.7–1.0 cm. longus utroque latere subbiflorus; pedicelli 1.0–1.2 cm. longi graciles glabri. Calycis lobi erecti virides aequales vel subaequales ovato-elliptici obtusi ca. 0.2 cm. longi extus puberulo-papillati intus basi minute plurisquamelligeri. Corollae delicatae versicolores tubus cylindricus ca. 1 cm. longus basi ca. 0.2 cm. diam. paulo infra medium staminiger ibique intus pilosus caeterumque glaber ut dicitur ruber ostio purpureo-rubellus lobi ut videntur gilvi patuli tubo aequilongi oblique obovati in alabastrum longiuscule ovoideum vix crassum dextrorsum involuti et implicati. Antherae sessiles latiuscule triangulares 0.35 cm. longae basi ca. 0.1 cm. latae apice sensim acuminatae basi tenuissime bilobatae filamenta adnata pilosula excepta ominino glabrae. Stigmatis pars apicalis subglobosa annulo basali tenuiter membranaceo patulo. Stylus ca. 1 cm. longus. Carpella glabra ovoidea apocarpa ca. 0.1 cm. alta nectario annulari ½ altitudinis ovarii attingente omnino adnato. Folliculi haud visi.

TYPE: rare shrub 1 m. high, corolla tube red, lobes reflexed, convolute, mauve-red center, Potaro River below Tukeit, British Guiana, May 16, 1944, *Maguire & Fanshawe 23482*. Missouri Botanical Garden; New York Botanical Garden.

I wish that I could assign *T. versicolor* to one of the segregate genera recognized by my friend Dr. Fr. Markgraf, of Berlin-Dahlem, in his revision of the American Tabernaemontanoideae (Notizbl. **14**: 151–186. 1938). As I understand them, the presence of a manifest though adnate nectary would assign our plant to *Tabernaemontana* in the very restricted sense, while the general habit of the plant recalls *Peschiera*. I am inclined to ally *T. versicolor* with such species known to me as *T. arcuata* and *T. psychotrifolia;* it might be viewed provisionally as a connecting link between the boreal *Tabernaemontana* and the austral *Peschiera* in much the same way as are *T. apoda* of Cuba, and *T. Schippii* of Central America. I have not yet become familiar with Markgraf's interpretation; therefore I probably shall create less confusion by continuing for the present to use *Tabernaemontana* in its broader sense.

LACMELLEA FLORIBUNDA (Poeppig) Benth. & Hook. SURINAM: tree to 10 m. tall, 15 cm. diameter, maka-pina-tete swamp, km. 13, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24848*. Northern Brazil, Surinam.

LACMELLEA ARBORESCENS (Muell. Arg.) Mgf. BRITISH GUIANA: 100 foot tree, 12 inches diameter, milk white, flowers white, fruit yellow, creek swamp, Moraballi Creek, Essequibo River, *F710;* 20 foot tree, 6 inches diameter, leaves leathery, glabrous, flowers bunched in axils, stalked, white, lobes reflexed, buds yellow-green, rocky island in falls, Kurihi Rapids, Essequibo River, *F1708;* 70 foot tree, 8 inches diameter, flowers axillary, tubular, white, mixed mora-turu forest, Makauria Creek, *F556*.

I have just received from my friend Dr. Fr. Markgraf a photostat copy of his restoration of *Lacmellea* (Notizbl. **15**: 615–629. 1941). Formerly I had been unimpressed by arguments for the congenericity of that genus and *Zschokkea* Muell. Arg. (cf. Monachino, in Lloydia **7**: 275. 1944); however, Markgraf disposes of all questions quite convincingly.

ASCLEPIADACEAE[103]

ASCLEPIAS CURASSAVICA L. SURINAM: seven-stemmed, unbranched, 1 m. high, rootstock horizontal, shrub savanna in sand, Charlesburg Rift, bordered by swamps and primary jungle, 3 km. north Paramaribo, *22729*. Widely distributed in tropical and subtropical America at low and moderate elevations; adventive in the eastern hemisphere.

BLEPHARODON NITIDUS (Vell.) Macbr. BRITISH GUIANA: rare, vine with white latex, trailing on *Byrsonima*, fruit elliptical, pendent, glossy green, Kaieteur Savanna, *23279*. SURINAM: flowers greenish, corona white, km. 68, vicinity Sectie O, *24996*. Colombia to northeastern Brazil.

GONOLOBUS RIPARIUS HBK. BRITISH GUIANA: vine with milky juice, from crown on unknown tree in ropy forest, leaves soft, scabrous, flowers in axillary fascicles on long peduncle, calyx green, reflexed, purple-tipped-corolla lobes convolute, green, fleshy, white-margined on one side, throat similarly white-rimmed, Takutu Creek to Puruni River, Mazaruni River, *F2064*. Eastern Colombia, Venezuela, British Guiana.

MATELEA STENOPETALA Sandwith. BRITISH GUIANA: occasional, vine, flowers pale cream, petals spreading, riverside, Potaro River above Kaieteur Falls, *23365*. British Guiana.

METASTELMA BRASILIENSE K. Sch. SURINAM: frequent, weak shrub becoming scandent or vine, flowers greenish, Savanna II, Tafelberg, *24236*; frequent, subshrub becoming a scandent and twining vine, flowers white, open rock, Savanna VIII, Tafelberg, *24527*. Guianas, eastern Brazil.

In 1941 I published the results of several years of delving into the generic outlines of the American Asclepiads (Ann. Missouri Bot. Gard. **28**: 193–244. 1941). I came to the conclusion that a return to the rather simple pre-Decaisnean, and in some instances pre-Brownian, classification was of distinct advantage. *Metastelma* was one of the several segregate genera whose return to *Cynanchum* I recommended, but without making any of the many new combinations. This was necessary at the time because of my inadequate knowledge of the nomenclatural situation in the majority of cases. My ignorance not being appreciably dissipated as yet, I am still labeling Metastelmas, etc., with their currently accepted names until such time as I can revise them competently.

METASTELMA STENOLOBUM Dcne. SURINAM: frequent, vine, flowers bronze without, throat bronze, river banks below rapids, Jacob kondre, Saramacca River, *23811*. British Guiana, Surinam, northern Brazil.

ROULINIELLA GUIANENSIS (Dcne.) Jonker. BRITISH GUIANA: vine with plentiful white gummy latex, from fallen tree at river edge, leaves soft, flowers in axillary fascicles, calyx green, petals thin, fleshy, white on reverse, purplish, striated paler on inner face, ring of leafy white staminodes [!] almost enclosing the stamens, Sebai Creek, Kaituma River, *F2423*. SURINAM: infrequent, vine, flowers with purple petals, white-striped within, corona white, river bank, vicinity Saron Creek, Saramacca River, *23772*; infrequent, petals white without, purple-striped within, vicinity Brokolonka, Saramacca River, *23789*. British Guiana, Surinam.

As in the case of *Metastelma* (vide ante), I am still of the opinion that *Rouliniella* should be returned to *Cynanchum*, although I am not in a position as yet to make the necessary transfers.

[103] By Robert E. Woodson, Jr.

TASSADIA PROPINQUA Dcne. BRITISH GUIANA: occasional, vine with milky latex, flowers white, riverside, Potaro River above Kaieteur Falls, *23350;* milky vine, leaves stiff, wiry stems, flowers in loose panicles, small corolla, calyx pale cream, fruit 2-horned, narrow-lanceolate or subulate, 1 inch long, Mazaruni Station, Mazaruni River, *F215*. Guianas, northern Brazil.

My remarks concerning *Metastelma* and *Rouliniella* apply to *Tassadia* as well.

CONVOLVULACEAE[104]

This is an enumeration of the Convolvulaceae collected by Bassett Maguire and his collaborators during the New York Botanical Garden Tropical Expedition—1944 in British Guiana and Surinam. Moreover a few notes are given on some other Convolvulaceae collected in Guiana which may be of interest as an addition to the author's papers on the Surinam representatives of this group, published in the Flora of Surinam **4**: 66–102. 1932; in Lanjouw, Additions to Pulle's Flora of Surinam, Rec. trav. botan. néerland. **32**: 255–257. 1935; and in Pulle, Flora of Surinam, Additions **4**: 468–471. 1937.

MARIPA GLABRA Choisy. SURINAM: rope, flowers pale blue, low forest, Coppenam River Headwaters, vicinity Blackwater Camp (No. 5), *24194*. Known from several localities in Surinam and from French Guiana (see Gleason in Bull. Torr. Bot. Club **56**: 111. 1929).

BONAMIA MARIPOIDES Hallier f. SURINAM: liana, climbing to 20 m., leaves dark green above, tawny sericeous beneath, Saramacca River, bush to rear of Jacob kondre, *23761*. Known from several localities in Surinam and from Northern Brazil.

ANISEIA MARTINICENSIS (Jacq.) Choisy. SURINAM: frequent, repent vine, flowers white, sandbanks along railroad bed, Saramacca River, Kwakogroen, *23779*. Widely spread through the tropics of the Old and the New World.

IPOMOEA FRAGRANS (Boj.) Boj. ex Choisy.

As I have pointed out in my paper on the Convolvulaceae of Malaysia, III, Blumea **3**: 564–566. 1940, *Ipomoea Parkeri* Choisy and its var. *subsericea* Meissn., described from British Guiana and from Surinam respectively, are synonyms of *Ipomoea fragrans* (Boj.) Boj. This name has priority and has to be used for the Guiana plants (See Van Ooststr., Flora Suriname **4**: 92. 1932, id. in Lanjouw, Additions, 1935, p. 256). Tropical America (British Guiana, Surinam); tropical Africa, Madagascar and adjacent islands; Malay Archipelago, Philippine Islands, in marshes along coasts and rivers or in marshy forests.

IPOMOEA TILIACEA (Willd.) Choisy. SURINAM: common, flowers blue, Charlesburg Rift, 3 km. north of Paramaribo, *22786*. Tropical America, West tropical Africa, in the Malay Archipelago only known from the Talaud Islands and from New Guinea.

IPOMOEA SQUAMOSA Choisy. BRITISH GUIANA: vine, corolla blue without, paler at base, deep blue distally within, basin of Rupununi River, Isherton, lat. about 2° 20′ N., edge of forest, *A. C. Smith 2464*. In Surinam only known from the Upper Sipaliwini River. Further in Northern Brazil, Colombia, Peru and Bolivia. Most probably new to British Guiana.

[104] By S. J. van Ooststroom.

IPOMOEA QUAMOCLIT L. SURINAM: frequent, vine, flowers rose-scarlet, Saramacca River, weed about village of Jacob kondre, *23800*. Circumtropical.

IPOMOEA PHILLOMEGA (Vell.) House. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River, clearings in high forest, frequent, vine, flowers purple-red. *23891*. Additional collections are: *A. C. Smith 3587:* n. w. slopes of Kanuku Mountains, in drainage of Moku-moku Creek (Takutu tributary), dense forest, alt. 150–500 m.; and *N. Y. Sandwith 248:* Essequibo River, Moraballi Creek, near Bartica, bush-rope in mixed forest, alt. near sea-level, sepals dull greenish-mauve, corolla pinkish-magenta. Both were received by the Utrecht herbarium under the name *Ipomoea cardiosepala* Meissn. SURINAM: frequent, flowers purple, along railroad near km. 70, *23637*. Tropical Central America and the West Indies through Colombia, Venezuela, British Guiana, Surinam and French Guiana to Northern and Eastern Brazil.

BORAGINACEAE[105]

CORDIA BICOLOR A. DC. BRITISH GUIANA: tree 90 feet high, 16 inches diam., unbuttressed, mixed forest, Takutu Creek to Puruni River, Mazaruni River, ***F2071*** (***F.D.*** *4807*). Widely distributed in tropical America.

CORDIA EXALTATA Lam. var. MELANONEURA (Klotsch) Johnston. BRITISH GUIANA: tree to 100 feet, 16 inches diam., leaves glossy, thick and brittle, fruit in flat panicles, black and fleshy when ripe, Moraballi Creek, Essequibo River, ***F589*** (***F.D.*** *3325*); small tree 12 feet high, same locality, ***F1281*** (***F.D.*** *4017*). Recorded only for middle and western British Guiana.

CORDIA FALLAX Johnston. BRITISH GUIANA: tree 90 feet high, 16 inches diam., unbuttressed, mixed forest, Takutu Creek to Puruni River, Mazaruni River, ***F2081*** (***F.D.*** *4817*). Apparently endemic to British Guiana.

CORDIA MACROSTACHYA (Jacq.) R. & S. SURINAM: shrub to 2 m. high, flowers white, open scrub land on sand, Charlesburg Rift, 3 km. north Paramaribo, *22776*. Widely distributed in tropical America.

CORDIA NERVOSA Lam. BRITISH GUIANA: small tree to 5 m. high, 3 cm. diam., flowers white, fruit globose, scarlet, occasional *Dicymbe* forest on white sand, Trail Tukeit to Kaieteur Plateau, *23094;* shrub or small tree 2 m. high, flowers white, fruit red, Kaieteur Savannas, *23400*. SURINAM: small tree, flowers white, opening in *Clusia* bush, vicinity Savanna VIII, Tafelberg *24624;* shrub, west escarpment, Tafelberg, *24673*. Kaieteur Savanna, British Guiana to French Guiana and adjacent Brazil. Apparently previously not recorded for Surinam.

CORDIA NODOSA Lam. BRITISH GUIANA: tree 6–7 m. high, *Mora* forest, Kamuni Creek, Groete Creek, Essequibo River, *22810*. Widely distributed in tropical America.

CORDIA POLYCEPHALA (Lam.) Johnston. SURINAM: shrub to 3 m. high, flowers white, open scrub land on sand, Charlesburg Rift, 3 km. north Paramaribo, *22778*. Widely distributed in tropical America.

CORDIA SCHOMBURGKII DC. SURINAM: subshrub, locally common in clearings, Kwatta hede, Saramacca River, *23924*. Guiana, Trinidad and Tobago.

[105] By I. M. Johnston.

VERBENACEAE[106]

AEGIPHILA ELATA Sw. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F1291.*

AEGIPHILA INTEGRIFOLIA (Jacq.) Jacks. BRITISH GUIANA: Potaro River Gorge, *23080;* approach to the Kaieteur escarpment, *23476.* The species is widely distributed from Trinidad, Venezuela, and Colombia to Bolivia and São Paulo, Brazil.

AEGIPHILA LAEVIS (Aubl.) Gmel. SURINAM: frequent, liana, second growth, secondary jungle, 3 km. north of Paramaribo, *22782.* The species is known also from Colombia, British and French Guiana, and Brazil.

AMASONIA CAMPESTRIS. (Aubl.) Moldenke. SURINAM: frequent, flowers cream, bracts orange-red, annual to 5 cm. tall, sand banks along railroad bed, Kwakoegron, Saramacca River, *23780.* The species is widespread from Trinidad, Venezuela, and the Guianas, to Brazil.

CITHAREXYLUM MACROPHYLLUM Poir. BRITISH GUIANA: Takutu Creek, Puruni River, Mazaruni River, *F2049.*

PETREA BRACTEATA Steud. BRITISH GUIANA: Kamuni Creek, *22885;* Groete Creek, Essequibo River, *F1734; F1735.* SURINAM: Coppenam watershed, *24831.* The species is known only from the Guianas and northern Brazil.

PETREA MACROSTACHYA Benth. BRITISH GUIANA: Takutu Creek, Puruni River, Mazaruni River, *F2118.*

STACHYTARPHETA CAYENNENSIS (L. C. Rich.) Vahl. BRITISH GUIANA: Potaro River, *22990.* SURINAM: Charlesburg Rift, Paramaribo, *22771.* The species is widely distributed from Mexico and Jamaica to Paraguay and Argentina.

STACHYTARPHETA JAMAICENSIS (L.) Vahl. BRITISH GUIANA: Potaro River, *22989.* SURINAM: roadside weed, Carl Francois, *23587.* The species is widely distributed from Florida and Mexico south to Matto Grosso and Pernambuco, Brazil.

VITEX COMPRESSA Turcz. BRITISH GUIANA: Essequibo River below Monkey Jump, *F1327;* Kaow Island, Essequibo River, *F831.* SURINAM: Saramacca River, *23902, 23910, 24011.* The species is known from Trinidad, Venezuela, Colombia, and the Guianas south to Ceará and Pará, Brazil, and possibly northern Peru.

VITEX STAHELII Moldenke. BRITISH GUIANA: Mazaruni Station, *F492.*

VITEX TRIFLORA Vahl. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F1292.* SURINAM: Coppenam watershed, *24837.* The species is known only from the Guianas, northern Brazil, and eastern Peru.

GESNERIACEAE[107]

Alloplectus savannarum Morton, sp. nov. Scandens, caulibus ca. 25 cm. longis, teretibus, non ramosis, deorsum ca. 5 mm. diam., dense flavo-tomentosis, epidermide haud squamosa; folia opposita, inaequalia, majora longe petiolata, petiolo 4–5 cm. longo, 1.5–2 mm. diam., flavo-tomentoso, lamina late elliptica, 13.5–15 cm. longa, 6–6.5 cm. lata, breviter acuminata, basi

[106] By Harold N. Moldenke.

[107] By C. V. Morton. Published by permi sion of the Secretary of the Smithsonian Institution.

valde obliqua, non decurrente, minora brevius petiolata (usque ad 1.3 cm.), lamina ovata, usque ad 7 cm. longa et 4.5 cm. lata, omnia herbacea, subtus pallidiora, perspicue dentata (dentibus utroque latere usque ad 40), basi subintegra, supra breviter pilosula, subtus dense pilosa, venis primariis in foliis majoribus 7–9-jugis, arcuatis; inflorescentiae axillares, floribus geminis, pedicellatis, pedicellis 9–12 mm. longis, crassis, densissime tomentosis, bracteis nullis vel mox deciduis; calyx coccineus, lobis erectis, paullo inaequalibus, postico et 2 anterioribus replicatis, 2 lateralibus subplanis, ambitu subovatis, ca. 3 cm. longis, basi fere 2 cm. latis, subcordatis, perspicue dentato-laciniatis (dentibus ca. 9 utroque latere), apice subintegris, utrinque dense flavo-pilosis; corolla flavescens, obliqua, basi non vel vix saccata, 25–28 mm. longa, tubo basi 6 mm. diam., glabro, sursum ampliato et curvato, dense flavo-sericeo, intus apicem versus parce pilosulo, usque ad 10 mm. diam., fauce contracto, ca. 7 mm. lato, limbo parvo, lobis 5, aequalibus, deltoideis, erectis, ca. 2 mm. longis et latis, rotundatis, externe sericeis, intus glabris; stamina in vaginam glabram ca. 8 mm. longam connata, filamentis subaequalibus, contortis, glabris, antheris primo connatis, 2 mm. longis, 2.5 mm. latis, glabris, loculis late oblongis, discretis; ovarium dense pilosum; stylus glaber; stigma bilamellatum; discus in glandulam posticam magnam glabram emarginatum reductus; placentae intus solum ovuliferae; capsula crassa, ca. 12 mm. longa, bivalvata, valvis explanatis; semina parva, ca. 1.5 mm. longa.

TYPE: Kaieteur Savanna, British Guiana, May 1, 1944, *Maguire & Fanshawe 23127*. New York Botanical Garden.

The present species belongs to the section *Eualloplectus*, which is the dominant section in the Andes but which has not been known previously from the Guianas. There are so many species in the section, most of them undescribed, that the relationship of the present one cannot be determined precisely at present.

CODONANTHE CALCARATA (Miquel) Hanst. *C. bipartita* L. B. Smith. BRITISH GUIANA: frequent epiphytic vine associated with ant nest, corolla white, pink-striped, Kamuni Creek, Groete Creek, Essequibo River, *22838;* soft woody perennial herb growing on ant nests on trees, pendent or creeping along branches, stem with adventitious roots, leaves fleshy, flowers two in each axil of uppermost leaves, perianth whitish, pinkish, or yellowish, with pale crimson dots, Mazaruni Station, Mazaruni River, *F1422*. SURINAM: savanna, Zanderij I, *25050*. Known only from the Guianas.

CODONANTHE CRASSIFOLIA (Focke) Morton. *C. confusa* Sandw. SURINAM: frequent epiphyte in tall trees, Agricultural Experiment station, Paramaribo, *22765*. Occurs from Costa Rica to northern South America.

Columnea guianensis Morton, sp. nov. Herba perennis, procumbens et adsurgens, caulibus non ramosis, usque ad 7 mm. diam., teretibus, striatis, sericeis, demum glabrescentibus; folia opposita, per paria valde inaequalia, majora breviter petiolata, petiolo ca. 1 cm. longo, sericeo, lamina oblanceolata, 20–23 cm. longa. 7–8 cm. lata, apice abrupte at breviter acuminata (1 cm.), basi valde inaequali, margine minutissime denticulata, supra juventute parce sericea, mox glabra, subtus leviter sericea, supra medium vel interdum fere ubique rubra, venis primariis 7–9-jugis, adscendentibus, utrinque paullo elevatis, secundariis obscuris; folia minora stipuliformia, subsessilia, lamina ovato-lanceolata. 1.5–2 cm. longa. 5–8 mm. lata. apice

gradatim argute acuminata, basi valde inaequalia, rotundata, subintegra, viridia, supra subglabra, subtus parce sericea; inflorescentiae axillares, floribus geminis vel ternis, breviter pedunculatis, pedunculo ca. 5 mm. longo, basi bracteas foliaceas paucas gerente; calyx herbaceus, viridis, ca. 2 cm. longus, lobis liberis, planis, erectis, lanceolatis, paullo inaequalibus, postico ca. 4 mm. lato, alteris 5 mm. latis, longe gradatim acuminatis, basi paullo angustatis, perspicue inciso-serratis, serraturis (apice glandulosis) ca. 7 utroque latere (postico ca. 5 utroque latere), intus glabris, externe dense flavido-sericeis; corolla erecta, flava, lobis externe sanguineis, usque ad 30 mm. longa, tubo basi postico paullo gibboso, anguste cylindrico, 4.5–5 mm. diam., externe dense flavido-sericeo, intus parce puberulo, limbo subregulari, lobis inferioribus subdeltoideis, ca. 2 mm. longis et latis, 2 superioribus fere usque ad apicem connatis; filamenta basi 2.5 mm. connata, suberecta, parce pilosula; antherae inclusae, subquadratae, 2 mm. longae et latae, liberae, connectivo parce piloso, loculis discretis; staminodium nullum; ovarium conicum, dense sericeum; stylus inclusis, glaber; stigma bilobum; discus in glandulam posticam glabram crassam emarginatam ca. 1.5 mm. longam reductus.

TYPE: rocky ground in mixed forest, Tukeit, Potaro River Gorge, British Guiana, April 28, 1944, *Maguire & Fanshawe, 23067*. U. S. National Herbarium; New York Botanical Garden.

Apparently related to *Columnea consanguinea* Hanst. of Costa Rica and Panama, which differs chiefly in its entire rather than incised-serrate calyx lobes. Seemingly *Columnea*, which is the largest American genus of Gesneriaceae, has not been known previously from British Guiana.

DRYMONIA CRISTATA Miquel. SURINAM: frequent succulent vine, corolla white, the upper lip yellow-spotted, fruit explanate, scarlet within, seeds minute, black, imbedded in the deliquescing axial material, river banks above Kwatta hede, Saramacca River, *23935*. Known only from Surinam, and to me previously only from description.

EPISCIA CILIOSA (Mart.) Hanst. BRITISH GUIANA: in white sand, Amatuk Portage, *23019*. This species has seemingly been known previously only from the original collection from Manacurú, Japura, District of Rio Negro, Brazil (*Martius* 3117). A photograph of the type in the Munich Herbarium has been distributed by the Chicago Natural History Museum. The species appears to be most closely allied to *Episcia glabra* (Benth.) Hanst. (*Centrosolenia glabra* Benth.) from Venezuela, with which it agrees particularly in the bearded anthers, fimbriate corolla lobes, and narrow, red, toothed calyx segments. However, *E. ciliosa* is a procumbent plant, bearing, at least ordinarily, only a single subapical leaf, whereas *E. glabra* is erect, with several leaves. The leaves are conspicuously appressed-pilose in *E. ciliosa* and, except for the petiole and midrib beneath, glabrous in *E. glabra*. I give below an amplified description.

Terrestrial or epiphytic, the stems thick, procumbent, unbranched, short, 4–5.5 mm. in diameter, red-pilose; leaves solitary, subapical, 25–43 cm. long, petiolate, the base subamplexicaul, the blade oblanceolate, 4.5–8.5 cm. wide, the apex abruptly long-acuminate, long-decurrent at base into the petiole, herbaceous in texture, green above, paler beneath, sharply serrulate, subappressed-pilose on both sides, the primary veins 7–12 pairs, ascending; inflorescences axillary, several-flowered, the common peduncle obsolete,

the pedicels slender, 1–2.5 cm. long, conspicuously red-hirsute, the basal bracts inconspicuous, linear, 3–5 mm. long, red, hirsute; calyx scarlet, the lobes 5, linear-lanceolate, erect, a little unequal, the shorter about 1.3 cm. long in anthesis, the longer about 1.6 cm. long, 2.5–3 mm. broad toward base, free, subulate at apex, remotely denticulate, especially toward the apex, red-pilose externally, glabrous within; corolla white, horizontal in the calyx, about 2.6 cm. long, spurred 1 mm. at base, the tube very narrow and slender at base (about 1 mm. in diameter), abruptly dilated upwardly, becoming 9 mm. wide in the throat, strigillose externally, glabrous within, the limb subbilabiate, the upper lobes fimbriate; stamens conspicuously didynamous, the filaments slender, glabrous, the anthers connate in pairs, about 1.5 mm. long and 1 mm. broad, the cells discrete, coarsely and conspicuously bearded at apex; ovary globose, sericeous; disk reduced to a glabrous, thick, solitary, ovate gland; placentae ovuliferous on the inner surfaces only.

EPISCIA DENSA C. H. Wright. BRITISH GUIANA: undersurface of leaves crimson, procumbent herb rooting at nodes, flowers white or lobes pale purple, locally abundant in woodland at Garraway Stream, Potaro River, *22982;* in white sand, Waratuk Falls, Potaro River Gorge, *23036.* Known only from British Guiana.

EPISCIA HIRSUTA (Benth.) Hanst. BRITISH GUIANA: stoloniferous perennial herb, stems and leaf veins red, flowers white, lobes pale violet, erose, locally frequent (but rarely flowering), in mixed forest, Tukeit, Potaro River Gorge, *23078.* Previously known to me only from description. The type was collected in British Guiana by Schomburgk.

EPISCIA MACULATA Hook. f. BRITISH GUIANA: scandent or closely climbing vine, occasional in *Mora* and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22826.* Known only from British Guiana.

EPISCIA sp. aff. E. CUNEATA Gleason. BRITISH GUIANA: locally frequent, flowers white, on moist rocks in high mixed forest, Potaro River Gorge, *23520.* Probably undescribed, but a description must be postponed until a complete survey of the genus can be made.

EPISCIA sp. BRITISH GUIANA: Waratuk Falls, Potaro River Gorge, *23047.* This perhaps represents a new species also, but it cannot be described at present.

TUSSACIA RUPESTRIS Benth. SURINAM: succulent perennial herb, locally frequent on exposed, wet, rocky slopes near base of Augustus Falls, at Cataract 3, Tafelberg, *24762.* Previously known only from British Guiana, and to me only from a collection (*A. C. Smith 3579*) from the Kanuku Mountains.

RUBIACEAE[108]

NAUCLEEAE

UNCARIA GUIANENSIS (Aubl.) Gmel. SURINAM: frequent liana, rope to 6 cm. diam., flowers greenish-white, river banks below rapids, Jacob kondre, Saramacca River, *23807.* Venezuela, Trinidad, and Guianas to Brazil and Bolivia.

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[108] By Paul C. Standley.

CINCHONEAE

COSMIBUENA GRANDIFLORA (Ruiz & Pavón) Rusby. BRITISH GUIANA: tree to 12 m. high, 10 cm. diam., flowers cream-colored, the corolla lobes flat, spreading, young fruit greenish, occasional to frequent, Kaieteur Savanna, *23226*. Widely distributed in northern and western South America.

COUTAREA HEXANDRA (Jacq.) Schum. SURINAM: shrub to 3 m. high, infrequent, sandy soil, scrub savanna, Charlesburg Rift, 3 km. north of Paramaribo, *22726*. Distributed at suitable elevations almost throughout tropical America.

FERDINANDUSA RUDGEOIDES (Benth.) Hook. f. SURINAM: tree to 20 m., 30 cm. diam., corolla green, the lobes white within, high mixed wallaba forest, km. 7, Camp No. 2, Saramacca River, headwaters *24879*. British Guiana; northern Brazil.

MANETTIA ALBA (Aubl.) Wernham. BRITISH GUIANA: vine, infrequent, along timber trail, high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22839*. Guianas and northern Brazil.

MANETTIA COCCINEA (Aubl.) Willd. SURINAM: vine, Island Camp, Toekoemoetoe Creek, Saramacca River, *24073*. Generally distributed in tropical America, from Mexico southward.

HENRIQUEZIEAE

HENRIQUEZIA JENMANI Schum. BRITISH GUIANA: tree 15 m. high, 20 cm. diam., from foreshore on sandy silt at or below tide level, rough-barked, with low buttresses or semi-stilt roots, leaves stiff, glaucous beneath, brittle, flowers creamy-white, corolla hairy inside, with crimson lines converging to the center, a ring of white wooly hairs at the mouth of a twist in the tube, crimson inside below the constriction, Bartica Point, Essequibo and Mazaruni River junction, *F847*. Known otherwise from the type, collected along the Mazaruni River, *Jenman 629*.

CONDAMINEAE

CHIMARRHIS CYMOSA Jacq. BRITISH GUIANA: tree 27 m. high, 40 cm. diam., with irregular spreading plank buttresses to 2 meters high, fluted, mixed forest on lateritic soil in rocky places, leaves thin-leathery, flowers white, sweet-scented, stamens white, Groete Creek, lower Essequibo River, *F1249*. Also in Kanuku Mountains; Venezuela; West Indies.

RONDELETIEAE

CHALEPOPHYLLUM GUIANENSE Hook. f. BRITISH GUIANA: shrub 2 m. high, woody below, stems quadrangular, the shoots fleshy, corolla white, salverform, the throat filled with yellow hairs, the tube suffused with reddish, fruit oblong, greenish, suffused with reddish, rare, Kaieteur Plateau, *23169*. Originally described from British Guiana, but without definite locality; also in the Gran Sabana region of Venezuela.

The genus *Chalepophyllum* is a small and interesting one, confined to this general region of northern South America. The only other species are *C. latifolium* Standl. of Mount Duida; *C. speciosum* N. E. Brown of Mount Roraima and Carrao-tepuí, and Ptari-tepuí, Venezuela; and *C. Tatei* Standl., of Mount Duida.

Elaeagia Maguirei Standl., sp. nov. Arbor 15-metralis, trunco 30 cm. diam., ramulis crassulis subteretibus glabris vel glabratis; stipulae deciduae, non visae, basibus persistentibus incrassatis spinuloso-ciliatis; folia modica firme chartacea, petiolo crassiusculo 6–10 mm. longo; lamina late elliptica 11–14.5 cm. longa 6–8 cm. lata, subabrupte acuta, basi cuneato-contracto et ad petiolum decurrens, supra glabra albido-puncticulata, costis prominulis, subtus fere concolor, sat dense albido-puncticulata, primo ut videtur minute puberula, in statu adulto glabrata, costa gracili elevata, nervis lateralibus utroque latere ca. 9 teneris prominentibus arcuatis adscendentibus, venulis prominulis arcte reticulatis; paniculae terminales sessiles magnae multiflorae, basi trichotomae, ramis gracilibus complanatis dense puberulis, repetite ramosis, floribus in cymulas paucifloras aggregatis, sessilibus; calyx cum hypanthio dense puberulus campanulato-obconicus 2 mm. latus truncatus; corolla alba extus glabra, fauce dense lanata, lobis reflexis tubo anguste obconico paullo longioribus; stamina longiexserta, filamentis glabris, antheris ca. 1.2 mm. longis.

TYPE: tree 15 m. high, 30 cm. diam., flowers white, frequent in high forest, alt. 625 m., base of south cliffs, Arrowhead Basin, Tafelberg, Surinam, August 23, 1944, *Maguire 24449*. Chicago Natural History Museum; New York Botanical Garden.

This is the first species of *Elaeagia* to be recorded from Surinam. The species with the nearest range, and the one most closely related, appears to be the Venezuelan *E. Karstenii* Standl. In that the calyx is shallowly but conspicuously lobate, the flowers distinctly larger, and the leaves, which are less acute, not white-puncticulate.

SIPANEA OVALIFOLIA Bremekamp. SURINAM: frequent, flowers white, vicinity of Camp 2, Saramacca River headwaters, *24135*. Frequent herb, flowers pink, opening in high bush, base of north escarpment, Tafelberg, *24314*. Known only from Surinam.

SIPANEA PRATENSIS Aubl. BRITISH GUIANA: flowers pale pink, occasional, sandy or rocky ground, Kaieteur Savannas, *23472*. Widely distributed in northern South America; Trinidad.

MUSSAENDEAE

COCCOCYPSELUM GUIANENSE (Aubl.) Schum. BRITISH GUIANA: repent and prostrate, flowers lilac, fruit deep china-blue, white sand, secondary forest, Waratuk Falls, Potaro River Gorge, *23048*. SURINAM: savanna, vicinity of Sectie O, *25022;* flowers pale blue, fruit dark blue, low forest floor, north of Savanna III, Tafelberg, *24283*. Widely distributed in tropical America.

GONZALAGUNIA SPICATA (Lam.) Gómez. BRITISH GUIANA: shrub to 2 m., flowers white, high forest, Kamuni Creek, Groete Creek, Essequibo River, *22878;* subshrub to 4 m., flowers white, fruit blue, common, banks and swamps along Kamuni Creek, *22926a*. Guianas and Brazil; West Indies.

ISERTIA HYPOLEUCA Benth. BRITISH GUIANA: tree to 10 m. high, 15 cm. diam., flowers red. yellow in the throat, locally frequent; essentially bush island, Kaieteur Savanna, *23132*. SURINAM: frequent, small tree to 10 m., 15 cm. diam., wood soft, flowers scarlet, primary jungle near Posoegronoe, Saramacca River, *24020*. Northern South America, southward to Peru.

ISERTIA PARVIFLORA Vahl. SURINAM: infrequent, tree to 12 m., flowers pink, the calyx red, river banks below rapids, Jacob kondre, Saramacca River, *23825*. Venezuela and Guianas; West Indies.

SABICEA ASPERA Aubl. BRITISH GUIANA: vine on low shrubs, stems reddish, flowers white, fruit dull crimson, Garroway Stream, Potaro River, *22957*. Guianas; northern Brazil.

SABICEA GLABRASCENS Benth. var. OBLONGIFOLIA (Miq.) Sandw. BRITISH GUIANA: vine, frequent to common, along timber trail, high mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22841*. SURINAM: frequent vine, flowers white, along railroad Sectie O, near km. 70, *23610;* frequent, divaricately branched, flowers white, fruit light blue, below rapids, Jacob kondre, Saramacca River, *23884*. Guianas; Amazonian Brazil; reported from Venezuela.

Schradera surinamensis Standl., sp. nov. Frutex scandens glaber, ramis crassis fusco-brunneis vel cinnamomeis, subteretibus; stipulae fusco-brunneae deciduae subvaginantes ca. 17 mm. longae, apice rotundatae vel obtusae; folia in sicco fuscescentia subcoriacea, petiolo crasso 13–20 mm. longo; lamina ovali-elliptica vel late oblongo-elliptica 10–16 cm. longa 5–8 cm. lata, late acuta vel subacuta, basi rotundata usque subacuta et saepe abrupte breviter decurrens, concolor, costa supra impressa, subtus prominenti, nervis lateralibus obscuris utroque latere ca. 11 tenerrimis angulo latiore quam recto abeuntibus fere rectis, prope marginem inaequaliter conjunctis; capitula terminalia dense multiflora 2 cm. lata vel paullo ultra, involucro ca. 12 mm. alto irregulariter breviterque lobato vel subintegro, pedunculo crasso 6–10 cm. longo; calyx brevis truncatus, limbo ca. 5 mm. latus.

TYPE: vine, scandent subshrub, flowers white, frequent in high forest, east facing slopes above escarpment, 300 m. south of East Ridge, Tafelberg, Surinam, August 29, 1944, *Maguire 24554*. Chicago Natural History Museum; New York Botanical Garden. Vine forming dense masses, flowers white, frequent, base of north escarpment, Tafelberg, *24323*.

This is the first member of the genus to be reported from Surinam. Until recently few specimens of *Schradera* have been collected in South America, but those now coming to hand in greater numbers indicate that the genus is represented there by a rather large number of only slightly different but apparently well marked species. The present one is conspicuously different from *S. polycephala* DC. of French and British Guiana, which has much smaller and relatively much narrower leaves, very obtuse or even narrowly rounded at the apex.

HAMELIEAE

BERTIERA GUIANENSIS Aubl. BRITISH GUIANA: shrub 2 m. high, mixed forest, flowers white, fruit pale china-blue, Takutu Creek to Puruni River, Mazaruni River, *F2182*. SURINAM: bush to rear of Jacob kondre, Saramacca River, *23755a*. Southern Mexico to Brazil and Bolivia.

BERTIERA sp. SURINAM: perennial herb with pink flowers, locally frequent in opening, base of north escarpment, Tafelberg, *24774*.

GARDENIEAE

ALIBERTIA TRIFLORA (A. Rich.) Schum. SURINAM: small tree to shrub,

flowers white, scentless, bush to rear of village of Jacob kondre, Saramacca River, *23858*. Surinam and French Guiana.

AMAIOUA CORYMBOSA HBK. SURINAM: frequent, small tree, flowers white, mixed wallaba forest, km. 23, Tafelberg, *24819*. Species new for Surinam; Guianas; Cuba; Central America.

AMAIOUA GUIANENSIS Aubl. BRITISH GUIANA: tree to 12 m., 15 cm. diameter, occasional to frequent, mixed forest, banks and swamp along Kamuni Creek, Essequibo River, *22930*. Venezuela and Guianas; widely distributed in Brazil.

DUROIA ERIOPILA L. f. BRITISH GUIANA: frequent, tree to 20 m. high, 20 cm. diameter, not buttressed, white sand, *Dicymbe* forest, immature fruit oblong-globose, as much as 7 cm. long and 6 cm. broad, greenish brown, mixed forest, Tukeit, Potaro River Gorge, *23051*.

DUROIA GENIPOIDES Hook. f. *D. Sprucei* Rusby. BRITISH GUIANA: tree 20 m. tall, 30 cm. diam., mixed forest on brown sand, leaves crowded at ends of branches, leathery, fruits terminal, solitary, globose, green and glossy, turning reddish brown when ripe, the flesh granular, edible, Mazaruni Station, *F1973*. SURINAM: tree 10 m. high, 15 cm. diam., corolla lobes creamy white, frequent, medium forest, between Savanna IV and V, Tafelberg, *24393;* tree 12 m. high, 15 cm. diam., flowers white, frequent, high mixed forest, south rim of Arrowhead Basin, Tafelberg, *24646*. Venezuela; Guianas; northern Brazil.

GENIPA AMERICANA L. BRITISH GUIANA: tree 6–8 m. high, 10–15 cm. diam., the branches spreading, leaves crowded at ends of branches, fruit globose, brown, edible, locally frequent, river side above Kaieteur Falls, *23369;* shrub or bushy tree of riverside vegetation, usually growing in the water, leaves thin-leathery, flowers white, anthers green, flowers turn yellow as they wither, Mazaruni River, *F2014*, vernacular name *Lana*. SURINAM: frequent tree, Grasi Falls, Saramacca River, *24937;* frequent, tree to 12 m. high, 30 cm. diam., flowers white, overhanging Tafelberg Creek, km. 5, *24893;* frequent, tree to 15 m. high, 8 cm. diam., dark pigment of fruit used by Carib Alasary, river banks below rapids, Jacob kondre, Saramacca River, *23835*. Widely distributed in tropical America.

POSOQUERIA LONGIFLORA Aubl. BRITISH GUIANA: tree 4 m. high, 3 cm. diam., hollow-stemmed, occasional, base Kaieteur escarpment below Tukeit, Potaro River, *23494;* slender tree 5–7 m. high, 5 cm. diameter, occasional, banks and swamp along Kamuni Creek, Essequibo River, *22936*. SURINAM: frequent, slender shrub or small tree hanging over river, one hour above Brokoboto Rapids, *23982;* frequent, arching shrub or small tree, flowers white, fruit white specked with green, yellow when mature, river banks above village of Kwatta hede, Saramacca River, *23928*. Guianas; northern Brazil and eastern Peru.

RANDIA ARMATA (Sw.) DC. BRITISH GUIANA: rope with tough gray skin, two inches diam. from mixed forest by creek, leaves paired, clustered at apex of short shoots, herbaceous, flowers white, hairy, calyx green. Mazaruni Station, *F917*.

RETINIPHYLLEAE

RETINIPHYLLUM LAXIFLORUM (Benth.) N. E. Brown. SURINAM, TAFELBERG: shrub to 3 m. high, flowers red, frequent, Savanna VII, *24439;*

shrub to 3 m. high, flowers red, fruit black, juicy, frequent, Savanna VII, *24786;* flowers deep pink or red, frequent, damp shaded walls, gorge above Lisa Falls, *24373;* frequent, flowers coral-red, Savanna I, *24220;* frequent, flowers deep pink or red, Savanna IV, *24373.* New for Surinam; also on Mount Roraima (Brazil, Venezuela, British Guiana).

Retiniphyllum Maguirei Standl., sp. (hybrid.?) nov. Frutex, ramulis subgracilibus, nodosis, nodis plerumque brevibus, breviter hispidulis; tubus stipularis fere 2 mm. longus puberulus; folia coriacea in sicco sublucida, petiolo 7–19 mm. longo breviter hispidulo; lamina elliptico-oblonga 4.5–6 cm. longa 2–3 cm. lata, obtusa, basi acuta, supra glabra, subtus paullo pallidior brunnescens sparse minute scaberula tactu asperula; flores racemosi, racemis usque ad 7 cm. longis, breviter pedunculatis, sparse paucifloris, rare ramosis, rhachi glabra vel glabrata, pedicellis oppositis vel interdum alternis 3–5 mm. longis crassiusculis sparse minuteque scaberulis; ovarium cum calyce 6–7 mm. longum glabrum, calyce tubuloso, apice 2.5 mm. lato truncato; corolla extus intusque dense albido-sericea, tubo 9–10 mm. longo, lobis patentibus vel reflexis late linearibus tubo paullo longioribus; genitalia longe exserta lobos corollae subaequantia.

TYPE: shrub to 3 m., flowers pink, frequent, Savanna IV, alt. 552 m., Tafelberg, Surinam, August 15, 1944, *Maguire 24374.* Chicago Natural History Museum; New York Botanical Garden. Shrub to 3 m., flowers coral-red, frequent, Savanna I, Tafelberg, *24220.*

The plant represented by these two collections is believed by Dr. Maguire to be possibly a hybrid between *R. laxiflorum* and *R. Schomburgkii,* and this hypothesis seems highly probable to the writer. The leaves are similar to those of *R. Schomburgkii,* but have rather less abundant pubescence; the leaves of *R. laxiflorum* are glabrous. The pedicels are much shorter than those of *R. laxiflorum;* the flowers of *R. Schomburgkii* are sessile. The calyx is glabrous and truncate as in *R. laxiflorum,* that of *R. Schomburgkii* being pubescent and conspicuously dentate. The shape of the corolla is like that of *R. Schomburgkii.* It is thus evident that the characters of *R. Maguirei* are intermediate between those of the putative parents, and a combination of them. All three of the species listed here, of course, grow on the same mountain.

RETINIPHYLLUM SCHOMBURGKII (Benth.) Muell. Arg. BRITISH GUIANA: shrub, 1 m. high, flowers whitish, the corolla lobes reflexed, fruit crimson, occasional, bush island, Kaieteur Savannas, *23168.* SURINAM: shrub to 2 m., savanna vicinity of Sectie O, *25014;* shrub to 2 m., corolla white, the lobes pink at the base, south savannas, vicinity of Arawak village, Mata, Zanderij I, *24985;* shrub to 3 m., corolla lobes pink or white with pink base, fruit 4 m., black, frequent, Savanna VII, Tafelberg, *24787; 24788;* shrub to 4 m., flowers red, frequent, Savanna I, Tafelberg, *24361;* frequent, Savanna IV, Tafelberg, *24372; 24374a.* Venezuela; Guianas; northern Brazil.

GUETTARDEAE

CHOMELIA TENUIFLORA Benth. SURINAM: infrequent, widely spreading, small tree 3 m. tall, 7 cm. diam., flowers white, spines sometimes 6–8 cm. long, bush to rear of Jacob kondre, Saramacca River, *23846.* British Guiana; Venezuela.

MALANEA ANGUSTIFOLIA Bartling. BRITISH GUIANA: stems 3 cm. diam.,

inflorescence and calyx green, fruit purple-black, along Potaro River below Tukeit, *23500*. Confined to British Guiana; originally collected by Schomburgk along the Demerara River; upper Mazaruni River, *Pinkus 218*.

This species, so far as the writer knows, never has been properly described and published.

MALANEA MACROPHYLLA Bartling. SURINAM: frequent, rope in low open bush, vicinity of Savanna IX, Tafelberg, *24648;* scandent shrub or vine, flowers white, frequent, Savanna VIII, Tafelberg, *24530*. Guianas; Venezuela; northern Brazil.

MALANEA SARMENTOSA Aubl. SURINAM: vine, leaves tawny-red, strongly rugose, wallaba forest, km. 7, Saramacca River Headwaters, *24871*. Guianas; Venezuela; northern Brazil.

IXOREAE

Ixora mazarunensis Standl., sp. nov. Frutex, praeter inflorescentiam fere omnino glaber, ramulis subteretibus gracilibus, internodiis elongatis; stipulae bene evolutae non visae, in tubum brevem coalitae, lobis brevibus latisque 1-costatis, apice acuminato-apiculatis; folia majuscula firme chartacea glabra, petiolo 1–1.5 cm. longo; lamina anguste elliptico-oblonga 16–17 cm. longa 5–5.5 cm. lata, abrupte acuminata, basi acuta vel attenuato-acuta, subtus paullo pallidior brunnescens, nervis lateralibus utroque latere ca. 9 tenerromis subtus prominulis, arcuatis, venis obsoletis; inflorescentia terminalis breviter pedunculata capituli-formis, pedicellis crassis dense pubescentibus usque ad 3 mm. longis sed vulgo brevioribus vel nullis, bracteis majusculis saepe calycem subinvolventibus; calyx late campanulatus dense puberulus, margine remote breviter dentato; corolla in alabastro 15 mm. longa extus subsparse puberula, tubo gracili lobis paullo longiore; fructus ovalis glabratus in sicco 8 mm. longus, basi rotundatus.

TYPE: shrub of *Mora* forest, to 2 m. tall; leaves leathery, pale beneath, buds red, fruit red, fleshy, Takutu Creek to Puruni River, British Guiana, November 7, 1944. *Fanshawe 2079* (*F.D. 4815*). New York Botanical Garden; photograph at Chicago Natural History Museum.

It is most unsatisfactory to describe new species in this genus, in which most of the known species appear to be poorly marked, and at best are poorly understood. Very few species have been described from the Guianas, in contrast with Brazil, and the present plant does not fall satisfactorily into any of them. It resembles *I. xantholoba* Standl., of the same general region, but in that the flowers are glabrous, and the corolla lobes scarcely half as long as the tube.

IXORA ORINOCENSIS Spruce. SURINAM. TAFELBERG: tree 12 m. high, 15 cm. diam., flowers yellow, turning orange, frequent, rim of Arrowhead Basin, *24475;* tree 10 m. high, 10 cm. diam., low bush 1.5 km. west of Savanna IV, *24413;* small tree 8 m. high, 10 cm. diam., flowers yellow, turning orange-red, frequent, low forest north of Savanna III, *24282*. The type is from Maipures on the Río Orinoco, Venezuela.

The species is new for Surinam. Here may belong also the following collection from British Guiana: Kaieteur Savanna, *23397;* a tree 4 m. high, 3 cm. diam., fruit green tinged with red, rare in low bush. At first this was believed to represent a new species, but the specimen is in fruit only, and it is believed better for the present to refer it with question to *I. orinocensis*.

IXORA XANTHOLOBA Standl. BRITISH GUIANA: shrub a meter high, or sometimes 4.5 m. tall, with habit of tree sapling, mixed forest on loamy soil, leaves thinly leathery, corolla tube pink, the limb rotate, yellow, the lobes slightly revolute, Takutu Creek to Puruni River, Mazaruni River, *F2016*. Known otherwise only from the type, from Twasinki, basin of Essequibo River.

COUSSAREAE

COUSSAREA PANICULATA (Vahl) Standl. BRITISH GUIANA: tree 9 m. high, 10 cm. diam., sometimes as much as 24 m. high, and diameter of 30 cm., inner bark discoloring to blue-green rapidly on exposure to air, flowers white, fleshy, the corolla lobes revolute, buds creamy, *Dicymbe* forest, trail from Tukeit to Kaieteur Falls, Potaro River Gorge, *23072;* tree 12 m. high, 15 cm. diam., yaru-amara forest on light brown sand, leaves thinly leathery, Ituni Road, Mackenzie, Demerara River, *F2498*. SURINAM: small tree, flowers white, leaves turned downward, fruit apparently white, Campo Dungeoman, Saramacca River, *24046;* small tree to 4 m., fruit white, 10 km. below confluence of Toekoemoetoe Creek with Saramacca River, *24057*. Venezuela; French Guiana; Trinidad.

COUSSAREA RACEMOSA A. Rich. SURINAM: tree to 12 m. high, 12 cm. diam., flowers white, frequent, high mixed forest, base of north escarpment, Tafelberg, *24299*. Also in French Guiana.

COUSSAREA SURINAMENSIS Bremekamp. SURINAM: tree 10 m. high, 10 cm. diam., high mixed wallaba forest, lateritic soil, km. 9.5, Coppenam River Headwaters, *24861*. Known previously only from the type, collected by Focke but without definite locality.

FARAMEA CAPILLIPES Muell. Arg. BRITISH GUIANA: shrub 2 m. high with horizontal branching, morabukea forest, leaves chartaceous, brittle like tin-foil, corollas greenish white, the lobes thick, revolute, Takutu Creek to Puruni River, Mazaruni River, *F2019;* erect shrub to 2.5 m. tall, same locality, *F2032*. SURINAM: frequent shrub or small tree to 4 m., high bush, base of north escarpment, Tafelberg, *24343;* frequent shrub to 3 m., flowers white, mixed high forest, same locality, *24776;* subshrub, fruit blue, low forest, between Camps 3 and 4, km. 15, Coppenam River Headwaters, *24156*. Guianas; Venezuela; northern Brazil, eastern Colombia and Peru.

The species has not been reported previously from Surinam, but the description of *F. quadricostata* Bremekamp suggests this species.

FARAMEA LONGIFOLIA Benth. BRITISH GUIANA: shrub 2 m. high, growing from rocks in falls, stems and leaves brittle, leaves stiff, at all angles from the stem, buds pale purple, Takutu Creek to Puruni River, Mazaruni River, *F2172*. SURINAM: infrequent small tree, the twigs green, flattened, leaves chartaceous, river banks below rapids, Jacob kondre, Saramacca River, *23831*. British Guiana; northern Brazil.

FARAMEA SALICIFOLIA Presl. SURINAM: small tree, fruit yellow, Tafelberg Creek, 5–10 km. below base camp, *24080*. Guianas; Venezuela and Colombia to northern Brazil and Bolivia.

PSYCHOTRIEAE

CEPHAELIS ALTSONI Sandwith. BRITISH GUIANA: perennial herb, leaves leathery, flowers white, the corolla lobes yellow within, bracts of the in-

florescence white, waxy, rare to occasional, white sand, secondary scrub forest, Amatuk Portage, Potaro River Gorge, *23018*. The type is from Macreba Falls, Kurupung River, Mazaruni River, and is described as a shrub of 1.5–3 m., collected at the type locality also by *Pinkus, no. 5*.

CEPHAELIS BARCELLANA (Muell. Arg.) Standl. BRITISH GUIANA: perennial semi-woody herb or subshrub of clearings in the forest, to 2 m. high, branched, bracts of the inflorescence scarlet, spreading, flowers pale yellow, Takutu Creek to Puruni River, Mazaruni River, *F2040;* local name Sailor's hat. Colombia and Venezuela to northern Brazil and eastern Peru.

Not reported previously from British Guiana. The plant is exactly like *C. tomentosa*, except that the long hairs of the lower leaf surface are closely appressed to the nerves, rather that spreading widely from them. Although considered a distinct species by Mueller, it is questionable whether the form is really essentially different from *C. tomentosa*.

CEPHAELIS CALLITHRIX Miq. *Gamotopea callithrix* Bremekamp. BRITISH GUIANA: subshrub a meter tall, all parts with blackish hairs, Morabukea forest, flowers white, Takutu Creek to Puruni River, Mazaruni River, *F2020*. SURINAM: perennial herb, flowers white, opening in high forest, base of north escarpment, Tafelberg, *24311;* divaricately branched, fruit light blue, swampy bush above village, along Saramacca Trail, Jacob kondre, *23884*. Guianas; northern Brazil, Trinidad.

Cephaelis Fanshawei Standl., sp. nov. Arbuscula, ramulis gracilibus teretibus, dense pilis longis laxis patentibus villoso-pilosis; folia elliptica vel anguste elliptica, petiolis 8 mm. longis vel brevioribus, dense patenti-pilosis; lamina 7.5–9.5 cm. longa, 3–4 cm. lata, breviter acuminata, basi acuta, utrinque pilis longis laxis patentibus mollibus conspersa, subtus paullo pallidior; inflorescentiae terminales breviter pedunculatae eis speciei *C. potaroensis* Sandw. similes; bracteae exteriores coccineae, ellipticoovales, ca. 3 cm. longae atque 1.5 cm. latae, obtusae vel subacutae, extus pilis longis albis laxis patentibus conspersae.

TYPE: soft-wooded tree 4 m. high, 2 cm. diam., flowers white, bracts scarlet, occasional, from wallaba forest, Kaieteur Savanna, British Guiana, May 8, 1944, *Maguire & Fanshawe 23296*. Chicago Natural History Museum; New York Botanical Garden.

In general appearance and in most of its characters this is like *C. potaroensis* Sandwith (Hook. Icon. *pl. 3300*. 1935), which is described and discussed by its author in great detail. That differs from *C. Fanshawei* in having the pubescence of the leaves and bracts of closely appressed hairs; its floral bracts are orange at first, turning dull dark red in age, and are acute or acuminate.

CEPHAELIS KAPPLERI (Miq.) Benoist. SURINAM: swampy bush above village along Saramacca Trail, Jacob kondre, *23881*. Apparently a rare species, only two collections, including the type, being reported in the *Flora of Surinam;* also in French Guiana.

CEPHAELIS POTAROENSIS Sandwith. BRITISH GUIANA: shrub, lax, dichotomously branched, flowers creamy, the calyx yellow, bracts orange, fruit oblong to globose, deep blue, Garroway Stream, Potaro River, *22966*. Known only from British Guiana, where it is rather widely distributed.

CEPHAELIS PUBESCENS Hoffmannsegg. BRITISH GUIANA: shrubby, 2 m.

high, bracts mauve-pink, fruit blue, seeds blue, occasional, riverside, above Kaieteur Falls, *23362*. SURINAM: frequent on rocky north slopes of Tafelberg, *25065;* frequent, shrub to 2 m., bracts deep purple, fruit blue, trail to Coppenam River to rear of Pakka Pakka, *23981*. Colombia and Venezuela; Guianas; northern Brazil; Trinidad.

CEPHAELIS TATEI Standl. *Psychotria crocochlamys* Sandw. Kew Bull. **1939**: 555. BRITISH GUIANA: subshrub to 1 m. high, bracts red-purple, rare, *Dicymbe* forest, Kaieteur Savanna, *23286*. Type from Mount Roraima; collected in British Guiana also on Membaru Creek, upper Mazaruni River; and in Venezuela on Ptari-tepui.

CEPHAELIS TOMENTOSA (Aubl.) Vahl. BRITISH GUIANA: perennial herb to 1 m. high, fruit 1.5 cm. long, obpyriform, pale blue, seeds dark blue, bracts scarlet, revolute, *Dicymbe* forest, riverside above Kaieteur Falls, *23376*. SURINAM: frequent, subshrub to 1 m., bracts orange-red, flowers cream, fruit light blue, savanna bush, along railroad, Sectie O, near km. 70, *23606;* frequent, Island Camp, Toekoemoetoe Creek, Saramacca River, *24074;* shrub to 2 m. high, flowers yellow, bracts bright orange-red, high forest, boulder stream talus, base of west escarpment, Tafelberg, *27200*. Generally distributed in wet lowlands of tropical America.

This is one of the most abundant, or at least one of the most often collected, Rubiaceae of tropical America, attracting attention because of its large and brightly colored inflorescence. The writer, from his own field experience with this rather weedy plant, is inclined to believe that it makes a handsomer showing in herbarium specimens than it does in the field.

CEPHAELIS VIOLACEA (Aubl.) Swartz. BRITISH GUIANA: subshrub to 2 m. tall, loosely branched, mixed forest on heavier soils, leaves stiff and brittle, branchlets, peduncles, and bracts blackish, fruit purple-black when ripe, Makauria Creek, *F698*. SURINAM: frequent subshrub, to 1.5 m. high, flowers white, montane forest, Krappa Camp (No. 2), Saramacca River Headwaters, *24145;* frequent, shrub to 1.5 m., fruit blue, secondary bush, Zanderij II, *23706*. Colombia and Venezuela; Guianas, northern Brazil.

GEOPHILA CORDIFOLIA Miq. SURINAM: frequent, repent herb, above village of Jacob kondre, along Saramacca Trail, *23870a*. Guianas; northern Brazil.

GEOPHILA HERBACEA (L.) Schum. SURINAM: common in deep shade, secondary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22789*. Generally distributed in the lowlands of tropical America.

PAGAMEA CAPITATA Benth. BRITISH GUIANA: tree 3 m. high, the trunk 10 cm. in diameter, leaves crowded at ends of branches, flowers greenish white, young fruit suffused with red, occasional to frequent, Kaieteur Plateau, *23185;* occasional to frequent, 3 m. high, 10 cm. diam., flowers greenish white, from bush island, Kaieteur Plateau, *23281*. SURINAM: common, shrub to 4 m., flowers white, fruit reddish, Savanna II, Tafelberg, *24252;* common, shrub to 5 m., 10 cm. diam., fruit red, Savanna I, Tafelberg, *24740*. Also in Venezuela.

The genus *Pagamea* probably is more accurately referable to Loganiaceae than to Rubiaceae, although it is referred to the latter family by various authors, and is treated here as a matter of convenience. The plants certainly have much in common with the Rubiaceae, if they are not actually referable there.

PAGAMEA GUIANENSIS Aubl. BRITISH GUIANA: tree to 3 m. high, with whorled branching, 10 cm. diam., flowers white, young fruit green suffused with red, glossy, occasional, bush island, Kaieteur Savannas, *23155*. SURINAM: rare, shrub to 4 m. high, savanna, Zanderij I, *23736a*. Venezuela; Guianas; rather widely distributed in Brazil.

PALICOUREA CROCEA (Sw.) DC. BRITISH GUIANA: shrub to 4 m., flowers lemon-yellow, inflorescence crimson in flower, mauve in fruit, ripe fruit black, locally frequent, inundated land, riverside above Kaieteur Falls, vicinity of Savanna I, Tafelberg, *24356;* shrub to 2 m. high, inflorescence bright coral in flower, purple in fruit, frequent, openings in low forest, vicinity of Savanna I, Tafelberg, *24356;* shrub to 2 m. high, inflorescence purple, frequent, high mixed forest, south rocky slopes, Arrowhead Basin, Tafelberg, *24612*. Widely distributed in tropical America, from Central America to Brazil and Bolivia.

PALICOUREA GUIANENSIS Aubl. BRITISH GUIANA: small tree 10 m. high, common, openings, *Mora* forests, Kamuni Creek, Groete Creek, Essequibo River, *22817*. SURINAM: tree 12 m. high, 15 cm. diam., bush to rear of Jacob kondre, Saramacca River, *23762* (referable to var. *trimera* Bremekamp). Central America; widely distributed in the wet lowlands of South America.

PALICOUREA NICOTIANIFOLIA Cham. & Schlecht. SURINAM: small tree to 5 m., 6 cm. diam., trail to Coppenam River to rear Pakka Pakka, *23976*. Brazil; reported from Colombia.

PSYCHOTRIA ASTRELLANTHA Wernham. *Chytropsia astrellantha* Bremekamp. BRITISH GUIANA: shrub of lax spreading growth, to 1 m. tall, *Mora* forest in damp places, young fruit reddish green, oval, with pale ribs, ripe fruit scarlet, Takutu Creek to Puruni River, Mazaruni River, *F2027*. SURINAM: frequent subshrub, flowers white, fruit red, low forest, line beyond Camp 4, Coppenam River Headwaters, *24165;* flowers greenish, infrequent, high mixed forest, base of north escarpment, Tafelberg, *24775;* frequent subshrub, flowers creamy, the buds orange, woodland, Base Camp, Tafelberg Creek, Saramacca River, *24891;* dense wallaba forest, Base Camp, *24088*. Known only from Surinam and British Guiana.

PSYCHOTRIA BARBIFLORA DC. BRITISH GUIANA: banks and swamp along Kamuni Creek, Essequibo River, *22933;* subshrub to 60 cm. high, with brittle stems and leaves, fruit purple when ripe, bracts purplish green, locally frequent, Kaieteur Savanna, *23340*. Venezuela; Guianas; Brazil; Trinidad.

PSYCHOTRIA CAPITATA Ruiz & Pavón. BRITISH GUIANA: subshrub to 2 m. high, fruit purple-black, Garroway Stream, Potaro River, *22961; 22959* from the same locality; lax, dichotomously branched shrub to 4 m. high, flowers white, plant brittle, shrub a meter high, of loose spreading habit, Morabukea forest, fruit greenish black, Takutu Creek to Puruni River, Mazaruni River, *F2037*. Central America southward to Bolivia; reported from British Guiana previously under the name *P. inundata* Benth.

PSYCHOTRIA CHIONANTHA (DC.) Britton. *Mapouria chionantha* Muell. Arg. SURINAM: small tree, river side en route to Pakka Pakka, Saramacca River, *23964;* shrub to 2 m. high, flowers white, frequent, Charlesburg Rift, 3 km. north of Paramaribo, *22761*. Guianas; Brazil.

PSYCHOTRIA CHLORANTHA Benth. BRITISH GUIANA: shrub 2–3 m. high, leaves fleshy, fruit crimson, inflorescence pale crimson, bush island, Kaieteur

Savanna, *23193*. SURINAM: infrequent shrub to 3 m. high, savanna, Zanderij I, *23729;* subshrub, inflorescence white in flower, purple in fruit, flowers purple, fruit dark purple, stems subsucculent, frequent, high forest, south base escarpment, Arrowhead Basin, Tafelberg, *24518*. Not reported previously from Surinam; also in Venezuela.

PSYCHOTRIA CUSPIDATA Bredem. BRITISH GUIANA: subshrub to 1 m. tall, from undergrowth of a rubber plantation on lateritic gravelly soil, flowers white, the corolla lobes revolute, fruit purple-black when ripe, Mabaruma, Aruka River, N. W. D., *F2357*. SURINAM: frequent shrub, to 4 m. high, flowers cream, fruit bilobate, light blue, pedicels red, primary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22799;* thickets, low bush bordered by *Montrichardia*, Lower Saramacca River, vicinity of Tawa Creek, *23751;* locally common, banks of Toekoemoetoe Creek, Saramacca River, *24905;* frequent, divaricately branched, in dense swampy bush above village along Saramacca Trail, Jacob kondre, *23875*. Southern Mexico to Trinidad, Brazil, and Peru.

PSYCHOTRIA DICHOTOMA (Rudge) Bremekamp. *Cephaelis dichotoma* Rudge. BRITISH GUIANA: occasional to frequent, subshrub to 60 cm. high, the leaves brittle, flower heads nodding, bracts purplish, the corollas pink, fruit dark blue, white sand, secondary forest, Waratuk Falls, Potaro River Gorge, *23040;* subshrub 1.5 m. high, of lax growth, young fruits greenish blue, the bracts purple, glossy, occasional, Kaieteur Savanna, *23255*. SURINAM: frequent subshrub, bracts and peduncles purple, corolla deep purple, low forest, between Camps 3 and 4, Coppenam River Headwaters, *24157*. Guianas; northern Brazil.

I am placing this species under *Psychotria* because it is so treated by Bremekamp in the *Flora of Surinam;* personally I believe it may be treated better as a species of *Cephaelis,* as was done by Rudge.

PSYCHOTRIA ERECTA (Aubl.) Standl. & Steyerm. *Ronabea erecta* Aubl.; *R. latifolia* Aubl.; *Psychotria axillaris* Willd. SURINAM: shrub to 7 m. high, flowers white, frequent in low forest, 1 km. south of Savanna I, Tafelberg, *24357*. Central America to Trinidad, Brazil, and Bolivia.

PSYCHOTRIA KAIETEURENSIS Sandw. BRITISH GUIANA: shrub 2 m. high, leaves brittle, fruit (immature) green, globose, inflorescence sometimes mauve, occasional to frequent in *Dicymbe* forest, trail from Kaieteur to Tukeit, *23475*. Known only from the type locality.

I am unable to suggest any clear relatives of this plant, but it appears to be a well-marked species, noteworthy for the large, abruptly acuminate leaves, yellow-green when dried, and for the very broad and strongly compressed panicle branches.

PSYCHOTRIA FOCKEANA Miq. *Mapouria Fockeana* Bremekamp. BRITISH GUIANA: low second-growth tree with spreading branches from forest edge, flowers white, calyx pale yellow, fruit orange-red, Mazaruni Station, *F1235;* vernacular name *Kamadan*. SURINAM: shrub to 3 m., mature fruit red-orange, swamps dominated by *Cyclanthus* and *Euterpe*, 1 km. southwest of Base Camp, Tafelberg Creek, *24089;* frequent, shrub to 3 m., scrub and secondary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22773*. Known only from Surinam and British Guiana.

PSYCHOTRIA LUPULINA Benth. BRITISH GUIANA: subshrub 1 m. high, laxly branched, brittle-stemmed, inundated areas in *Mora* forest, bracts pale

green, corollas white, anthers rose-pink, Takutu Creek to Puruni River, Mazaruni River, *F2007*. Colombia to the Guianas, Brazil and Bolivia.

Psychotria Maguirei Standl., sp. nov. Frutex 3-metralis, omnino glaber, ramis gracilibus, subteretibus vel in statu juvenili subcompressis, internodis plerumque elongatis; stipulae ad apicem tantum ramuli persistentes, ceterae deciduae, late lanceolato-lineares, ca. 12 mm. longae et 2.5–3 mm. latae (perfecte evolutae non visae), arcte striatae, rigidae, pallidae; folia majuscula, crasse membranacea, breviter petiolata, in sicco fusco-viridescentia, petiolo 12–17 mm. longo; lamina oblanceolata-oblonga vel oblongo-elliptica, 14–21 cm. longa, 5–8.5 cm. lata, subabrupte longeque angusto-acuminata, basi acuta vel saepe attenuato-acuta, nervis supra in sicco prominulis, subtus paullo pallidior, costa gracili elevata, nervis lateralibus utroque latere ca. 9, arcuatis, angulo fere recto vel angustiore adscendentibus, teneris, prominentibus; inflorescentia terminalis vel serius ob axem elongatum lateralis, cymoso-corymbosa, longipedunculata, 3–6 cm. longa, 4–7 cm. lata, erecta, pauciflora, ramis basalibus 2–3 adscendentibus, basi ut videtur non bracteatis, crassis, superne pauciramosis, floribus sessilibus subcapitato-congestis; flores non visi; fructus bicarpellatus intense caeruleus subdidymus, ca. 8 mm. altus atque 12 mm. latus, apice breviter bilobus, basi late rotundatus, pyrenis 5–6 mm. longis dorso laevibus, facie interiore planis.

TYPE: a shrub 3 m. high, fruit dark blue, from montane forest, line beyong Camp 4, Coppenam River Headwaters, Surinam, July 24, 1944, *Maguire 24169*. Chicago Natural History Museum; New York Botanical Garden.

I am quite unable to suggest a definite relationship for this species, which is in fruit only, and has no particularly outstanding characters. The form of the stipules is somewhat puzzling, since all are deciduous except those at the ends of the branchlets, but the plant is not referable to the subgenus *Mapouria*, which is distinguished by deciduous stipules. The somewhat didymous fruit is distinctive, but much larger than in other Psychotrias having that type of fruit.

PSYCHOTRIA MAPOURIA Roem. & Schult. BRITISH GUIANA: tree 3–4 m. high, 6 cm. diam., flowers greenish white, frequent, bush island, Kaieteur Savanna, *23133*. British and French Guiana; northern Brazil.

PSYCHOTRIA OFFICINALIS (Aubl.) Raeusch. *P. involucrata* Swartz; *P. Hoffmannseggiana* Muell. Arg. SURINAM: frequent, open subshrub to 1.5 m. high, divaricately branched, peduncles and bracts purple, fruit white at maturity, dense bush above Jacob kondre along Saramacca trail, Saramacca River, *23874*. Southern Mexico to Trinidad, Brazil, and Bolivia.

PSYCHOTRIA BOSTRYCHOTHYRSUS Sandw. BRITISH GUIANA: shrub to 2.5 m., the stems 3 cm. in diameter, corolla white, the lobes reflexed, occasional, rocky *Dicymbe* forest, trail from Tukeit to Kaieteur, Potaro River gorge, *23073;* subshrub of mixed and greenheart forest, pedicels mauve, buds faintly yellow, corolla pink, fruit purple-black when ripe, Mazaruni Station, *F532*. SURINAM: frequent, slender, divaricately branched shrub or small tree, the twigs green, wallaba forest and pina swamps, Base Camp, Tafelberg Creek, Saramacca River, *24111a;* also *24111a* from same locality. Previously known only from British Guiana.

PSYCHOTRIA PATENS Swartz. BRITISH GUIANA: low shrub, dense thickets, heavy *Mora* forest, Kamuni Creek, Groete Creek, Essequibo River, *22868*.

SURINAM: fruit light purple, Saramacca River banks, en route to Kwatta hede, *23952*. Southern Mexico to the West Indies, Brazil and Bolivia.

PSYCHOTRIA RACEMOSA (Aubl.) Raeusch. *Nonatelia racemosa* Aubl. BRITISH GUIANA: shrub a meter high, lax spreading habit, moist *Mora* forest, fruit orange-scarlet, Takutu Creek to Puruni River, Mazaruni River, *F2038*. SURINAM: occasional, fruit orange-red, low bush bordered by *Montrichardia,* Lower Saramacca River, vicinity Tawa Creek, *23750;* frequent, fruit red, dense bush, swampy bush above village along Saramacca Trail, Jacob kondre, *23876*. Costa Rica to West Indies, Brazil, and Bolivia.

In this species the fruit is 5-celled, and this is the basis for its separation as the genus *Nonatelia*. A careful account of the Psychotrieae of Surinam was published by Bremekamp, and the species of that country are disposed satisfactorily by him in the *Flora of Surinam.* His alignment is satisfactory for the Psychotrias of that one region, but does not take into account the very numerous species of other parts of tropical America—and the Old World. Until a comprehensive treatment of the group as a whole is published, it seems to the writer almost necessary to treat all the species of *Psychotria,* in the traditional sense of that group, as constituting a single, highly polymorphic genus.

PSYCHOTRIA ULIGINOSA Swartz. *Notapleura uliginosa* Bremekamp. BRITISH GUIANA: flowers white, fruit red, plant succulent, the stipules thick, projected downward, infrequent, dense second-growth,, Kamuni Creek, Essequibo River, *22860*. Southern Mexico to Panama and West Indies; widely dispersed in northern South America.

RUDGEA CORNIFOLIA (Humb. & Bonpl.) Standl. *R. fimbriata* (Benth.) Standl.; *Strempelia fimbriata* Bremekamp. BRITISH GUIANA: much-branched shrub of inundated *Mora* forest by river, to 2.5 m. tall, flower buds greenish cream, Takutu Creek to Puruni River, Mazaruni River, *F2080;* shrub 2–2.5 m., laxly branched, brittle, gregarious by water paths in *Mora* forest, calyx green, corolla white, the lobes recurved, same locality, *F2002*. Southern Mexico to Colombia, the Guianas, and northern Brazil.

RUDGEA CORNIGERA Bremekamp. SURINAM: infrequent, shrub to 3 m., fruit red, Zanderij II, *23705*. Known only from Surinam.

RUDGEA HOSTMANNIANA Benth. BRITISH GUIANA: tree 6 m. high, 10 cm. diam., tall secondary forest on lateritic gravelly soil, leaves thick-leathery, stiff, brittle, inflorescence white, the corollas white, fleshy, wooly inside, Mabaruma, Aruka River, N. W. D., *F2393*. SURINAM: infrequent shrub or small tree to 4 m., fruit red, river banks below rapids, Jacob kondre, *23833*. Venezuela; Guianas.

RUDGEA GRACILIFLORA Standl. BRITISH GUIANA: shrub or small tree to 3.5 m. tall, morabukea forest on lateritic soil, flowers white, calyx small, white, flowers sweetly scented, Takutu Creek to Puruni River, Mazaruni River, *F2041.*

It is with some doubt that this collection is referred to *R. graciliflora,* which is known otherwise only from the type, from the Rio Macubirjim in the Breves region, Pará, Brazil. The type specimen, formerly in the Berlin herbarium, presumably has been destroyed, but there is a good photograph and a fragment of it in the Chicago Herbarium. The leaves of the British Guiana plant are larger than those of the type specimen, but otherwise I am unable to find any differences between the two collections.

SPERMACOCEAE

BORRERIA CAPITATA (Ruiz & Pavón) DC. SURINAM: frequent, flowers white, Savanna III, Tafelberg, *24272*. Generally distributed in tropical South America.

BORRERIA LAEVIS (Lam.) Griseb. BRITISH GUIANA: herb to 1.5 m. high, flowers white, damp soil, openings in *Mora* and mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22920*. SURINAM: frequent, flowers white, primary jungle near Posoegronoe, *24023*. Generally distributed as a weed throughout tropical America.

BORRERIA VERTICILLATA (L.) Meyer. SURINAM: frequent, flowers white, Zanderij I, *23735*. Generally distributed in tropical America.

DIODIA HYSSOPIFOLIA (Willd.) Cham. & Schlecht. SURINAM: frequent, flowers pinkish, sand pockets in rocks, Grasi Falls, Saramacca River, *24941*. Colombia to Venezuela, Brazil, and Bolivia.

DIODIA SARMENTOSA Swartz. SURINAM: infrequent vine, climbing to 4–5 m., river banks below rapids, Jacob kondre, Saramacca River, *23821*.

MITRACARPUS DISCOLOR Miq. SURINAM: infrequent, flowers white, savanna, Zanderij I, *23734*. British Guiana; northern Brazil.

PERAMA DICHOTOMA Poepp. & Endl. BRITISH GUIANA: flowers blue, locally frequent, dry rocky ground, Kaieteur Savanna,. *23211*. SURINAM: frequent, flowers blue, base of dripping cliffs, Tafelberg, *24192*. The species is new for Surinam; also in Venezuela and Brazil.

PERAMA GALIOIDES Poir. BRITISH GUIANA: flowers yellow, damp sand, Kaieteur Savanna, *23129*. Venezuela; northern Brazil.

PERAMA HIRSUTA Aubl. SURINAM: frequent, flowers yellow, shallow bogs, Savanna I, Tafelberg, *24212;* flowers yellow, along railroad km. 70. Sectie O, *23629*. Trinidad; Guianas; Venezuela.

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THE CHEMICAL NATURE OF "CASSIC ACID": ITS IDENTIFICATION AS RHEIN[1]

MARJORIE ANCHEL[2]

The isolation of an antibiotic substance, "cassic acid," from the leaves of *Cassia reticulata* Willd. was reported in this journal recently by Robbins, Kavanagh and Thayer (1). Chemical investigation of this substance has shown it to be an anthraquinone derivative possessing two hydroxyl groups and a carboxyl group. Since the properties of "cassic acid" resembled those of rhein, a substance previously isolated from *Rheum officinale* (2), and from *Cassia angustifolia* (3), a comparison of the two compounds was made. For this purpose, rhein was isolated from *Rheum officinale* ("Rhubarb Root, U.S.P., Chinese," Penick), and was also prepared synthetically. Both samples proved to be chemically identical with the antibiotic substance from *Cassia reticulata*, and possessed the same antibiotic activity against *Staphylococcus aureus*. Identity of "cassic acid" with rhein establishes its structure as 4, 5-dihydroxy anthraquinone 2-carboxylic acid (4, 5, 6, 7).

THE NEW YORK BOTANICAL GARDEN
NEW YORK

Literature Cited

1. **Robbins, W. J., Kavanagh, F. & Thayer, J. D.** Bull. Torrey Botanical Club **74:** 287–292. 1947.
2. **Hesse, O.** Pharm. Jour. (IV) **1:** 325–327. 1895.
3. **Tutin, F. & Clewer, H. W. B.** Jour Chem. Soc. **99:** 946–967. 1911.
4. **Fischer, C., Falco, F. & Gross, H.** Jour. Prakt. Chem. **83:** 208–214. 1911.
5. **Fischer, C. & Gross, H.** Jour. Prakt. Chem. **84:** 369–382. 1911.
6. **Eder, R. & Widmer, C.** Helv. Chim. Acta. **5:** 3–17. 1922.
7. ————. Helv. Chim. Acta **6:** 419–424. 1923.

[1] A more detailed report will appear in the Journal of Biological Chemistry.

[2] This investigation was supported in part by a grant from the Albert H. and Jessie D. Wiggin Foundation.

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TORREYA

FIELD TRIP REPORTS

April 4, 1948. Pine Barrens. The trip for *Corema conradii* in the pine barrens was successful. We regret that Mr. Frazee's illness made it impossible for him to conduct the tour. First stop was at the stand of tall pines, mostly *Pinus echinata,* near Sym Place. The crowberry was in flower and thrifty in appearance. Pollination was mostly over. One member of the party reported it as being at the height of pollination on March 30. Other plants in flower at this date were *Pyxidanthera barbulata, Chamaedaphne calyculata, Epigaea repens,* and the *Carex umbellata.* Red maple flowers had dropped.

After lunch the group visited places in the West Plains to see further displays of *Corema.*

Attendance 14. Leader, David Fables.

April 10, 1948. Watchung Reservation. A walk through the Watchung Reservation with the Reptile Study Society of America yielded a few early spring plants such as *Dicentra cucullaria, Sanguinaria canadensis,* and *Erythronium americanum.* Several great blue herons were noticed flying overhead while the party was eating lunch at Surprise Lake. Unfortunately the day was quite cold and the herpetological results were confined to a few red-backed salamanders (*Plethedon cinereus*).

Attendance 3. Leader, Nellie L. Condon.

April 18. Flatbrookville Road to Harding Lake. Some fallen logs were cut from across the Appalachian Trail and the usual clipping of vegetation along the pathway was accomplished. Our section is in good hiking condition. The group also hiked north from Flatbrookville Road to Harding Lake. *Saxifraga virginiensis* and *Epigaea repens* were the only flowers seen on the ridge of the mountain. Later, in a hemlock glen near Blairstown, all of the expected plants of early spring were found in bloom.

Attendance 9. Leader, John A. Small.

April 24. Darby Creek. A joint trip with the Botanical Society of Pennsylvania. The Darby Creek location is only about fifteen minutes by trolley from the western extremity of Philadelphia and is the best botanizing area near city limits. Plants observed were *Polemonium reptans* just coming into bloom, *Dentaria heterophylla,* a plant which reaches the northern limit of its range here, and *Ranunculus ficaria. Sedum ternatum* was also found but is probably not native in this area. The group proceeded to Crum Creek, a short distance farther from the city and off the beaten track, where several uncommon plants were found, notably *Obolaria virginica,* also at the northern edge of its range, *Hybanthus concolor,* and *Poa cuspidata.*

Attendance 32. Leader, Dr. Walter Steckbeck.

April 25. Sparta to Springdale. Weather and flora conspired to make the day an enjoyable one for all participants. After assembling at the Sparta Post Office the group proceeded by car to the railroad station where cars were parked and a short foray into a nearby swamp was made. *Trollius laxus* and *Cardamine douglasii* were produced in full bloom, as well as an interesting array of early spring plants in various stages of development.

Sparta Glen, a magnificent stand of hemlocks with a little mountain stream flowing through it, was chosen for lunch. It was particularly interesting to note the survival of *Streptopus roseus* here, since it was recorded in Britton's "Catalogue of Plants Found in New Jersey" for 1887.

Through the kindness of Mr. Lee Edwards we were permitted a glimpse of a rare horsetail (*Equisetum pratense*) in a neighboring glen.

The group then made a short trip to the limestone belt at Springdale to see some of the more interesting ferns found in that locality. En route home a final foray was made into a wooded swamp near Succasuna under Mr. G. G. Nearing's guidance where *Helonias bullata* was coming into bloom, as well as *Coptis trifolia.*

We were very fortunate on this field trip to have such able botanists as Mr. E. J. Alexander, Mr. Lee Edwards, and Mr. G. G. Nearing to help us out of any difficulties in identification which confronted us during the day.

Attendance 20. Leader, James K. McGrath.

May 2. Netcong to Cranberry Lake. From Netcong, N. J., the group drove about four miles to an abandoned stretch of Lackawanna R.R. right of way. The footwork took us along a stream where *Caltha palustris* was conspicuously in flower. We passed Jefferson Lake and reached a charming hemlock glen. Passing the Cascade Iron Mines, which have been out of operation for some seventy years, we climbed over some ridges, crossed a swamp and descended through long abandoned fields to the vicinity of Cranberry Lake, thence back along the railroad. A list of 35 plants in flower or imminently so, excluding weeds, was compiled. Besides the *Caltha*, the display of violets in white, yellow, and blue was perhaps the most impressive.

Attendance 21. Leader, Major Lyman Barry.

May 2, 1948. Silver Lake, White Plains, N. Y. A trip to one of the few good botanizing areas surviving near New York City. Some 68 species of plants were recorded. The fine display of *Orchis spectabilis* was the highlight of the trip.

Attendance 18. Leader, Farida A. Wiley.

May 8–9, 1948. Camp Thendara, Palisades Interstate Park, N. Y. A joint trip with the New York Section of the Green Mountain Club. Camp Thendara was as big and hospitable as always with the largest attendance recorded in the history of the bird censuses. We are indeed grateful to the New York Section of the Green Mountain Club and our hostess Mrs. Laura W. Abbott for the excellent arrangements.

Saturday was cold and overcast but one group hiked from camp to the Fingerboard Mountain Shelter via the Appalachian Trail, and thence up the Arden Valley Road to the fire tower. None of the forest trees were in full leaf. *Amelanchier canadensis* was observed in bloom.

A plant seen on Sunday, possibly new for the season's listing was *Polygala pauciflora*. Sixty-one bird species were identified in the field under Mr. Howard H. Cleave's able leadership.

Attendance 49. Leader, Laura W. Abbott.

May 8, 1948. Slabsides, West Park, N. Y. The annual pilgrimage of the Torrey Botanical Club and John Burroughs Association to "Slabsides," the rustic retreat where many of the philosopher's essays were written. Over 150 species of plants were identified in the area. The presence of Mr. Edwin W. Teale, Dr. Clyde Fisher, Princess Teata and Professor Inez Haring contributed much to a very successful outing.

Attendance 30. Leader, Harold N. Moldenke.

May 9, 1948. Surprise Lake, Bearfort Mountain, N. J. The lake was well named. It was indeed a surprise to find a northern bog flora readily accessible by trail in our region. A black-spruce and tamarack association at the southern end of the lake yielded such plants as *Kalmia polifolia, Andromeda glaucophylla, Calla palustris, Vaccinium Oxycoccus, Nemopanthus mucronata, Ilex monticola*, and *Coptis trifolia.*

Luncheon was enjoyed at Prospect Rock, a fine open ledge on the east side of Bearfort Mountain with wonderful views of the entire length of Greenwood Lake and the surrounding Highlands.

After descending to Lakeside by easy trail, the group proceeded by car to Sterling Forest, N. Y., for a glimpse of *Clematis verticillata, Panax quinquefolia,* and *Viola rostrata.* An interesting fungus noted at this locality was *Gyromitra brunnea.*

Attendance 15. Leader, James K. McGrath.

May 15, 1948. South River, N. J. A visit to one of the outlying "Islands" of the New Jersey Pine Barrens. Some nice patches of *Pyxidanthera barbulata* with a few

flowers remaining were found and exhibited to those members who had not seen the plant in bloom. An excellent variety of Quercus species in flower was noted here, including *Q. ilicifolia, Q. stellata, Q. velutina, Q. coccinea, Q. alba, Q. Prinus,* and *Q. marilandica.* The floral characteristics, time of flowering, and color of the early vernal leaves of each species were discussed. Other plants seen at this locality were *Vaccinium pennsylvanicum, Gaylussacia baccata, Amelanchier stolonifera, Carex umbellata,* and *C. pennsylvanica.*

Old Bridge, the next stop, was even more reminiscent of the typical pine-barren country with its characteristic white sand. Additional species recorded were *Arenaria caroliniana, Hudsonia tomentosa, Juncus Greenei,* and *Prunus maritima.* Near the traffic circle a fine stand of *Pinus echinata* was examined by the group.

Attendance 9. Leader H. K. Svenson.

May 21–23, 1948. Branchville Nature Conference. Another very interesting "gathering of the nature clans" at Sussex Pines with Mr. Wallace Husk. The excellent program, able leadership, and comfortable surroundings seem to be omnipresent at all the conferences, for which we should express our thanks to the Program Committee.

Mr. Charles Roth had an especially fine night for astronomy. All five major planets were observed in the sky during the early part of the evening.

Those of the group interested in minerals were taken to a limestone quarry by Mr. Skidmore for fluorescent minerals. He also exhibited a number of nice specimens from his extensive collection.

Other field trips were led by Mr. David Fables for birds and Dr. H. N. Moldenke for trees and flowering plants. A color film by Mr. and Mrs. Schaugheneys and a lecture on birdbanding by Mrs. H. Carnes completed the program.

Attendance 85. Leader, James Hawley.

May 22, 1948. Avalon, N. J. A joint trip with the Botanical Society of Pennsylvania. The group botanized from train windows en route and were rewarded with many fine views of *Lupinus perennis* in full flower. An albino clump was spotted by Dr. J. M. Fogg, Jr. Between Tuckahoe and Cape May Courthouse a nice display of *Senecio tomentosus* was seen. In complete contrast to the blue and yellow plants, a field of *Trifolium incarnatum* supplied the primary red with its dark red flowers.

Upon reaching Avalon the group walked toward the ocean and then south on a gravel road paralleling the beach to "Open Hou.e," the summer residence of Mr. George E. Lippincott. The most interesting plant found during the day was recorded from this locality:—*Myosotis micrantha* in flower and abundant in the surrounding vacant lots. This little *Myosotis* was not reported by Fender in her "Flora of Seven Mile Beach, N. J." (Bartonia No. 19, 1937) but was collected on the Torrey trip to Point Pleasant, N. J., under similar conditions on May 16, 1943. It was also found in Ocean City, N. J., in July, 1935, by the late Dr. Charles R. Bridgett, a Philadelphia eye specialist with botany as a hobby. Taylor, in his "Flora of Vicinity of New York, 1916," lists the plant as a waif. It certainly is thoroughly established now along a good stretch of the South Jersey coast and it would be interesting to see how well represented the species is in the various herbaria. Other plants recorded in this area were *Smilacina stellata, Silene pennsylvanica, Aquilegia canadensis, Arabis lyrata, Cirsium spinosissimum, Amelanchier stolonifera, Trifolium dubium, Festuca octoflora,* and *F. rubra.*

The group had lunch on the "Open House" dune which is the second highest dune on the Jersey coast. Fine unobstructed views of the ocean and inland waterway with its extensive marshes were available.

After lunch the group botanized along the dunes and strand. The usual plants such as *Ammophila, Psedera, Prunus maritima,* etc., were abundant on the dunes as well as *Lathyrus maritimus* and *Lonicera sempervirens.*

The return to Cape May Court House by bus allowed about twenty minutes to make a brief foray into a nearby wooded swamp to see if *Helonias bullata* was still in flower, but was unsuccessful, as only a few mature fruting spikes were seen.

Attendance 13. Leaders, Louis E. Hand, George E. Lippincott, John M. Fogg.

May 23, 1948. Ardsley, N. Y. A leisurely walk from Ardsley to Elmsford, N. Y.

gave the group an opportunity to observe an impressive number of plants. About 85 species were recorded by the leader.

The outstanding botanical "find" on this trip was a number of specimens of *Helianthus mollis*, not in bloom, observed along the Saw Mill River Parkway. This species is not recorded for the locality in Taylor's "Flora of Vicinity of New York."

Other interesting plants not familiar to the group were *Duchesnea indica*, *Hydrophyllum virginianum*, *Tragopogon pratensis*, *Hieracium pilosella*, and *Antennaria neodicoica*. Two unusual mosses were found in fruit *Dicranella rufescens* and *Hygroamblystegium irriguum*. Fungi were represented by a fine specimen of *Morchella crassipes*.

Attendance 14. Leader, William Rissanen.

May 30, 1948. Bartlett Tree Research Laboratories. The trip included an extremely instructive tour of the laboratory grounds with its evergreen plantings, rock gardens, various experimental plots for spray tests, and the insectory where the life cycles of various tree insects are studied.

Particularly interesting to the members was the Bartlett Chestnut, a fine blight-resistant oriental chestnut. This was the parent tree which was severely damaged by the hurricane of 1944. Hundreds of seedlings were grown from this tree and before the hurricane as much as fifty pounds of nuts were harvested annually. It is not blight-immune but decidedly resistant to the chestnut bark-disease. Over 3,000 seedlings from the tree have already been distributed throughout the United States as well as Italy and northern Africa. The Bartlett Chestnut seeds naturally as the old American Chestnut did.

Attendance 12. Leader, Harold N. Moldenke.

News Note

The McCollum-Pratt Fund for the Study of Trace Elements. Dr. Isaiah Bowman, president of Johns Hopkins University, has announced a generous gift by one of its Trustees, Mr. John Lee Pratt, of Fredericksburg, Virginia. The gift will be known as the McCollum-Pratt Fund after Dr. E. V. McCollum, the noted authority on nutrition and discoverer of vitamins A and D, and the donor, Mr. Pratt. The fund will be devoted to the study of the effects of the so-called "trace" elements upon plants, animals, and man.

In explaining the purpose of the study, Dr. Bowman pointed out that research during the past twenty-five years has shown to an increasing degree that exceedingly small amounts of certain minerals, so small as to be designated only as "traces" in most chemical analyses of soils and plants, have an effect—sometimes profound—on the health of plants and animals. Their absence or deficiency leads to "deficiency diseases" of considerable range. Among the conspicuous examples of "trace" elements are copper, boron, cobalt, and manganese.

An interdepartmental committee will act as an advisory board to help select suitable personnel and guide the project. The four departments and their representatives initially concerned are: biochemistry (Dr. McCollum), geography (Dr. Robert L. Pendleton), sanitary engineering (Dr. Abel Wolman), and preventive medicine (Dr. Perrin H. Long). Dr. George F. Carter, chairman of the Department of Geography, will act as secretary of the advisory group until a special staff is assembled.

Notice

Approximately $1000.00 is available in the Mary S. Andrews research fund of the Torrey Botanical Club. This may be awarded, in whole or in part, for any aspect of botanical research, during the year 1949. Applications should be addressed to Edwin B. Matzke, Department of Botany, Columbia University, New York 27, N. Y., not later than March 1, 1949.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

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ALGAE

Davis, Charles C. *Gymnodinium brevis* sp. nov., a cause of discolored water and animal mortality in the Gulf of Mexico. Bot. Gaz. **109**: 358–360. *f. 1, 2.* 26 Mr 1948.

McNeill, Ellis Meade. A contribution to the knowledge of West Virginia algae. Castanea **13**: 1–56. Mr [Ap] 1948.

Papenfuss, George F. Further contributions toward an understanding of the *Agrochaetium-Rhodochorton* complex of the red algae. Univ. Calif. Publ. Bot. **18**: 433–447. 30 Je 1947.

Papenfuss, George F. New marine algae from South Africa: I. Univ. Calif. Publ. Bot. **23**: 1–16. *pl. 1–4.* 12 D 1947.

Smith, G. M. On the structure and reproduction of *Spongomorpha coalita* (Rupr.) Collins. Jour. Ind. Bot. Soc. M. O. P. Iyengar Commemoration volume: 201–208. *f. 1–5.* 1946 [17 F 1947].

Taylor, William Randolph. Pacific marine algae of the Allan Hancock expeditions to the Galapagos Islands. Allan Hancock Pacific Exped. **12**: *i–iv,* 1–316. *pl. 1–100 f. 1–13.* 1945.

Wood, R. D. On Rafinesque's names for the Characeae. Bull. Torrey Club **75**: 282–285. 17 My 1948.

FUNGI AND LICHENS

(See also under Plant Physiology: **Ajello**)

Barnett, Horace L. New reports of Iowa fungi. II. Proc. Iowa Acad. **53**: 137–140. 1947 [My 1948].

Gilman, Joseph C. Illustrations of the fleshy fungi of Iowa. VIII. The stinkhorns. Proc. Iowa Acad. **53**: 147–151. *f. 1–5.* 1947 [My 1948].

Greene, H. C. Notes on Wisconsin parasitic fungi. X. Am. Midl. Nat. **39**: 444–456. Mr [My] 1948.

Hedrick, Joyce. Some lichens from the American tropics collected by Wm. R. Taylor. Allan Hancock Pacific Exped. **3**: 183–187. 1942.

Karling, John S. Chytridiosis of scale insects. Am. Jour. Bot. **35**: 246–254. *f. 1–49.* Ap [My] 1948.

Martin, G. W. Additions to Galapagos fungi. Pacif. Sci. **2**: 71–77. *f. 1, 2.* Ap 1948.

Miller, Julian H. Fungi of the Dominican Republic—Xylariaceae. Jour. Agr. Univ. Puerto Rico **29**: 57–68. Ap 1945.

Murrill, William A. Florida polypores. Lloydia **10**: 242–280. D 1947 [Ap 1948].

Ritchie, Don. The development of *Lycoperdon oblongisporum.* Amer. Jour. Bot. **35**: 215–219. *f. 1–35.* Ap [My] 1948.

Sparrow, F. K. Jr., Phycomycetes recovered from soil samples collected by W. R. Taylor on the Allan Hancock 1939 Expedition. Allan Hancock Pacific Exped. **3**: 101–110. *pl. 16, 17.* 1940.

Timnick, Margaret Barton. Culturing Myxomycete plasmodia for classroom use. Proc. Iowa Acad. **53**: 191–193. *f. 1.* 1947 [My 1948].

BRYOPHYTES

Conard, Henry S. Phenology of mosses in Iowa. Proc. Iowa Acad. **53:** 141–146. 1947 [My 1948].

Kucyniak, James. Sur une mousse du Québec passée inaperçue. Contrib. Inst. Bot. Univ. Montréal **62:** 3–6. 1946–47 [My 1948].

Kucyniak, James. Une autre espèce de *Barbula* pour le Québec: *B. convoluta.* Contrib. Inst. Bot. Univ. Montréal **62:** 7–9. 1946–47 [My 1948].

Steere, William Campbell. The Bryophyta of the Allan Hancock Expedition of 1939. Allan Hancock Pacific Exped. **13:** 1–4. 1946.

SPERMATOPHYTES

(See also under Plant Physiology: **Hodge**)

Allen, Caroline K. Lauraceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75:** 307–316. 17 My 1948.

Ames, Oakes. Orchids in retrospect; a collection of essays on the Orchidaceae. *i-xix,* 1–172. *illust.* Bot. Mus. Harvard Univ. Cambridge. 1948.

Amshoff, G. J. H. Balanophoraceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75:** 303. 17 My 1948.

Antropov, V. I. & V. F. Sinópsis de las especies y variedades del genero *Secale.* Revista Argent. Agron. **15:** 33–52. Mr 1948.

Backeberg, Curt. The genus *Arthrocereus.* Cactus & Succ. Jour. **20:** 2–4. *f. 2, 3;* 21–24. *f. 16–19.* 1948.

Barroso, Liberato Joaquim. Chaves para a determinação de géneros indígenas e exóticos das Monocotiledôneas do Brasil. Rodringuésia **10[20]:** 55–77. *pl. 1–6 + foto A–C.* D 1946 [1947].

Booher, L. E. & Tryon, R. M. A study of *Elymus* in Minnesota. Rhodora **50:** 80–91. 9 Ap 1948.

Brade, A. C. Espécies novas da flora do Brasil. Rodriguésia **10[20]:** 41–46. *pl. 1–7.* D 1946 [1947].

Brade, Alexandre Curt & Barbosa Pereira, Altamiro. Contribuição ao Estudo da flora indigena. Rodriguésia **10[20]:** 83–88. *pl. 1–4.* D 1946 [1947].

Brade, A. C. & Barbosa Pereira, A. Relatório de uma excursão a São Sebastião do Paraiso, Minas Gerais. Rodriguésia **10[20]:** 121–132. *1 pl.* D 1946 [1947].

Brenckle, J. F. Notes on *Polygonum. III.* Phytologia **2:** 402–406. Ap 1948.

Brown, Babette I. A study of the distribution of epiphytic plants in New York. Am. Midl. Nat. **39:** 457–497. *f. 1 + tables 1, 2.* Mr [My] 1948.

Carlson, Margery C. Additional plants of El Salvador. Bull. Torrey Club **75:** 272–281. *map.* 17 My 1948.

Cave, Marion S. & Constance, Lincoln. Chromosome numbers in the Hydrophyllaceae: III. Univ. Calif. Pub. Bot. **18:** 449–465. *f. 1–5.* 22 O 1947.

Claus, Edward P. A study of anemophilous plants of Puerto Rico. Bot. Gaz. **109:** 249–258. 26 Mr 1948.

Clausen, Robert T. A new shrubby species of *Sedum* from the Sierra Madre del Sur. Cactus & Succ. Jour. **20:** 36, 37. *f. 28.* 1948.

Clement, Ian D. *Sida* in Oklahoma. Rhodora **50:** 99. 9 Ap 1948.

Cornman, John F. A note about an alleged discussion of *Juniperus.* Phytologia **2:** 401, 402. Ap 1948.

Correll, Donovan S. Some revisions of American orchids. Lloydia **10:** 209–234. D 1947 [Ap 1948].

Craig, Robert E. & Dawson, E. Yale. Two new Mammillarias from Puebla and Oaxaca, Mexico. Allan Hancock Found. Occas. Pap. **2**: 57–68. *pl. 17–19.* 1948.

Cutler, Hugh C. A comparative study of *Tripsacum australe* and its relatives. Lloydia **10**: 229–234. D 1947 [Ap 1948].

Dawson, E. Yale. New cacti of southern Mexico. Allan Hancock Found. Occas. Pap. **1**: 1–52. *pl. 1–16 + f. 1–17.* 1948.

De Azambuja, David. Nova Apocynaceae do Brasil. Rodriguésia **10**[20]: 51–54. *pl. 1.* D 1946 [1947].

De Azambuja, David. Retificacao da diagnose genérica de secondatia e apresentacao de espécie nova para o Brasil. Rodriguésia **10**[20]: 9–12. *pl. 1, 2.* D 1946 [1947].

Dimitri, Milán J. Dos nuevas plantas adventicias para la flora Argentina. Revista Invest. Agric. [Buenos Aires] **1**: 283–286. *f. 1, 2.* O 1947.

Eastham, J. W. Supplement to 'Flora of southern British Columbia' (J. K. Henry). Brit. Col. Prov. Mus. Spec. Publ. **1**: 1–119. 1947.

Dodds, K. S. & Simmonds, N. W. Genetical and cytological studies of *Musa.* IX. The origin of an edible diploid and the significance of interspecific hybridization in the banana complex. With an addendum on the nomenclature of edible bananas. Jour. Genetics **48**: 284–296. *pl. 11 + f. 1–10.* 1948 .

Epling, Carl. A synopsis of the tribe Lepechinieae (Labiatae). Brittonia **6**: 352–364. *f. 1–8 chart.* 26 Mr [8 Ap] 1948.

Fernald, M. L. *Rorippa:* a correction. Rhodora **50**: *100.* 9 Ap 1948.

Fernald, M. L. A small gathering of blackberries. Rhodora **50**: 73–80. *pl. 1093–1096.* 9 Ap 1948.

Fraga, M. V. G. Ensaio de indice da flora dendrológica do Brasil. Arq. Serv. Flor. [Rio de Janeiro] **2**: 67–156. N 1946 [1947].

Gentry, Howard Scott. Additions to the flora of Sinaloa and Nuevo León. Brittonia **6**: 309–331. *f. 1–6.* 26 Mr [8 Ap] 1948.

Gleason, H. A. Notes on South American melastomes. Phytologia **2**: 428–432. *1 f.* Ap 1948.

Goodman, Geo. J. Notes on *Eriogonum.* Am. Midl. Nat. **39**: 498–504. *map 1, 2 + graph 1.* Mr [My] 1948.

Guillaumin, A. Plantes nouvelles, rares ou critiques des serres du muséum. Bull. Mus. Hist. Nat. [Paris] **19**: 352, 353. 1947 [1948].

Hill, A. W. & Salisbury, E. J. Index kewensis plantarum phanerogamarum; Supplement 10. 1–251. Oxford. 1947.

Kellogg, Gertrude E. The asters of Iowa. Proc. Iowa Acad. **53**: 153–166. 1947. [My 1948].

Krukoff, B. A. & Monachino, J. Supplementary notes on the American species of *Strychnos*—III. Brittonia **6**: 343–351. 26 Mr [8 Ap] 1948.

Kuhlmann, J. G. O género *Eucalyptus* no Brasil. Arq. Serv. Flor. [Rio de Janeiro] **2**: 1–37. *pl. 1–21.* N 1946 [1947].

Kuhlmann, J. G. Uma nova Bignoniácea da Serra dos Orgãos. Rodriguésia **10**[20]: 7, 8. *1 pl.* D 1946 [1947].

LaRue, Carl D. The lilacs of Mackinac Island. Am. Midl. Nat. **39**: 505–508. *f. 1 + table 1.* Mr [My] 1948.

Little, Elbert L. A proposal to stabilize plant names. Phytologia **2**: 451–456. Ap 1948.

Lakela, Olga. Ferns and flowering plants of Beaver Island, Lake Superior, Minnesota. Bull. Torrey Club **75**: 265–271. 17 My 1948.

Lakela, Olga. A prostrate *Rorippa* in the interior. Rhodora **50:** 132. My 1948.

Machado, Othon. Contribuição ao Estudo das plantas medicinais do Brasil—O Guaraná. Rodriguésia **10**[20]: 89–110. *pl. 1–13* + *f. 1–5.* D 1946 [1947].

Machado, Othon. O fruto da *Vanilla Chamissonis* Kltz. Rodriguésia **10**[20]: 49, 50. *1 pl.* D 1946 [1947].

Maguire, Bassett, *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75:** 286–323. 17 My 1948.

Martinez Crovetto, Raul. Las Umbeliferas cultivadas en la República Argentina. Revista Invest. Agr. [Buenos Aires] **1:** 3–51. *f. 1–8.* 1947.

Martinez Crovetto, Raul. Nota taxonomica sobre *Wilbrandia sagittifolia* Griseb. (Cucurbitaceae). Bol. Soc. Argent. Bot. **1:** 312–317. *f. A–L.* 1946 [1948].

Mennega, A. M. W. Proteaceae [of Guiana]. *In:* Maguire, Bassett, *et. al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75:** 299, 300. 17 My 1948.

Merrill, E. D. Unlisted new names in Alphonso Wood's botanical publications. Rhodora **50:** 101–130. My 1948.

Moldenke, Harold N. Additional notes on the genus *Aegiphila.* IX. Phytologia **2:** 433–450. *f. 1–5.* Ap 1948.

Moldenke, Harold N. Menispermaceae [of Guiana]. *In*: Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torr. Club **75:** 306, 307. 17 My 1948.

Moldenke, Harold N. Notes on new or noteworthy plants. IV. Phytologia **2:** 408–428. Ap 1948.

Monachino, Joseph V. A new species of *Eupatorum* from the West Indies. Phytologia **2:** 406, 407. Ap 1948.

Monachino, Joseph V. A new species of *Ptychocarpus* from Peru. Phytologia **2:** 432–433. Ap 1948.

Muelleg-Melchers, F. C. Cacti of Uruguay [*Notocactus*]. Cactus & Succ. Jour. **20:** 40, 41. 1948.

Occhioni, Paulo. Uma nova espécie de Iridaceae da flora do Distrito Federal. Rodriguésia **10**[20]: 79–81. *1 pl.* D 1946 [1947].

Parodi, Lorenzo R. Gramíneas argentinas nuevas o críticas. Revista Argent. Agron. **15:** 53–61. *f. 1–3.* Mr 1948.

Pennell, Francis W. The taxonomic significance of an understanding of floral evolution. Brittonia **6:** 301–308. 26 Mr [8 Ap] 1948.

Ponce de Leon, Antonio. Joyas de la flora Cubana, El Algarrobo del Pais (*Samanea Saman* Merrill). Revista Soc. Cub. Bot. **4:** 35. *1 pl.* Ap–Je 1947 [1948].

Raymond, Marcel. Coup d'oeil sur la flore de Vaudreuil. Contr. Inst. Bot. Univ. Montréal **62:** 21–29. *f. 1.* 1946–47 [My 1948].

Raymond, Marcel. Notes sur la double distribution de certaines espèces boréales. Contr. Inst. Bot. Univ. Montréal **62:** 11–14. 1946–47 [My 1948].

Rice, H. P. A rough-barked American beech. Jour. Forest. **46:** 48. Ja 1948.

Rickett, H. W. Orthography in botanical nomenclature. Brittonia **6:** 365–368. 26 Mr [8 Ap] 1948.

St. John, Harold. Report on the flora of Pengelap Atoll, Caroline Islands, Micronesia, and observations on the vocabulary of the native inhabitants: Pacific Plant Studies 7. Pacif. Sci. **2:** 97–113. *f. 1–9.* Ap 1948.

Sandwith, N. Y. *Erigeron compositus* var. *glabratus* [N. Am.]. Bot. Mag. NS **165:** *pl. 2* + *f. 1.* Ap 1948.

Sandwith, N. Y. *Mandevilla Sanderi* [Brazil]. Bot. Mag. NS **165**: *pl. 7 + f. 1.* Ap 1948.

Sealy, J. Robert. *Penstemon Newberryi* f. *humilior* [N. Am.]. Bot. Mag. NS **165**: *pl. 4 + 1 f.* Ap 1948.

Sherff, Earl Edward. A name for the ''alpha'' variety or forma of miscellaneous dicotyledonous plants. Brittonia **6**: 332–342. 26 Mr [8 Ap] 1948.

Smith, A. C. Myristicaceae [of Guiana]. *In:* Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75**: 307. 17 My 1948.

Smith, Lyman B. New names for two Brazilian species. Rhodora **50**: 132. My 1948.

Soriano, Alberto. Los géneros de Quenopodiáceas de la flora argentina. Revista Argent. Agron. **15**: 1–18. *f. 1–5.* Mr 1948.

Standley, Paul C. Moraceae [of Guiana]. *In:* Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75**: 293–299. 17 My 1948.

Summerhayes, V. S. *Oncidium oblongatum* [Mexico?]. Bot. Mag. NS **165**: *pl. 5 + 1 f.* Ap 1948.

Vargas C., César. Algunas especies de *Bomarea* (Amaryllidaceae) raras o criticas del Perú. Bol. Mus. Hist. Nat. [Lima] **10**: 58–75. *f. 1–4.* 1946.

Waterfall, U. T. Distributional notes and some minor forms from Oklahoma. Rhodora **50**: 91–98. 9 Ap 1948.

Wolf, Carl B. Taxonomic and distributional studies of the New World Cypresses. Part I of The New World Cypresses. El Aliso **1**: 1–248. *f. 1–37.* 10 Ap 1948.

Wolf, Carl B. Horticultural studies and experiments on the New World Cypresses. Part III of The New World Cypresses. El Aliso **1**: 323–438. *f. 47–80.* 10 Ap 1948.

Yuncker, T. G. Piperaceae [of Guiana]. *In:* Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III. Bull. Torrey Club **75**: 286–292. 17 My 1948.

PALEOBOTANY

Barghoorn, E. S. Sodium chlorite as an aid in paleobotanical and anatomical study of plant tissues. Science **107**: 480, 481. 7 My 1948.

Machado, Othon. Fruto fossilizado do Itabirito. Rodriguésia **10**[20]: 47. *pl. 1.* D 1946 [1947].

ECOLOGY AND PLANT GEOGRAPHY

(See also under Genetics: **Heiser & Whitaker**)

Anderson, W. A. An ice-push ridge. Proc. Iowa Acad. **53**: 121, 122. *f. 1.* [My 1948].

Ashby, Eric. Statistical ecology. II. A reassessment. Bot. Rev. **14**: 222–234. Ap 1948.

Canfield, R. H. Perennial grass composition as an indicator of condition of southwestern mixed grass ranges. Ecology **29**: 190–204. *f. 1–5 + tables 1–4.* Ap 1948.

Curtis, John T. & Partch, Max L. Effect of fire on the competition between blue grass and certain prairie plants. Am. Midl. Nat. **39**: 437–443. *f. 1–3 + tables 1–3.* Mr [My] 1948.

Gates, Frank C. Colonization of certain aquatic plants on an open shoal. Ecology **29**: 205–208. *f. 1 + table 1.* Ap 1948.

Hansen, Henry P. Postglacial forests of the Glacier National Park region. Ecology **29:** 146–152. *f. 2.* Ap 1948.

Hieronymus, Jorge. Observaciones sobre la vegetación de la Provincia de Tucumán. Monogr. Inst. Estud. Geogr. [Tucumán] **5:** 1–162. *map.* 27 F 1945.

Miller, Robert C. A comparison of leaves of *Quercus coccinea* Muench. and *Betula lenta* L. from heath bald and mesophytic ravine habitats. Proc. Iowa Acad. **53:** 171–174. 1947 [My 1948].

Morales Macedo, Carlos. La vida en los mares del Perú. Bol. Mus. Hist. Nat. [Lima] **10:** 3–31. *illust.* 1946.

Veloso, Henrique P. Considerações gerais sôbre a vegetação do Estado de Mato Groso. I—Notas preliminares sobre o cerrado. Mem. Inst. Oswaldo Cruz **44:** 579–603. *f. 1–19.* D 1946.

Veloso, Henrique P. A vegetação no município de Ilhéus, Estado da Bahia. I—Estudo sinecológico das áreas de pesquisas sôbre a febre amarela silvestre realizado pelo S. E. P. F. A. Mem. Inst. Oswaldo Cruz **44:** 13–103. *f. 1–34 + tables 1–9 + graphs 1–18.* Mr 1946. II—Observação e ligeiras considerações acêrca de espécies que ocorrem na região. Chave analitica das espécies arbóreas. 221–293. Je 1946. III—Caracterização da vegetação pelo valôr dos indices das espécies. 323–341. *f. 1, 2 + tables 1–6.* Je 1946.

Wilde, S. A., Whitford, Philip B. & Youngberg, C. T. Relation of soils and forest growth in the driftless area of southwestern Wisconsin. Ecology **29:** 173–180. *f. 1, 2 + tables 1, 2.* Ap 1948.

PHYTOPATHOLOGY

(See also under Plant Physiology: **Walker & Kendrick**)

Aikman, J. M. Seasonal development in the grape following frost injury. Proc. Iowa Acad. **53:** 115–119. *f. 1, 2 + table 1.* 1947 [My 1948].

Alvarez Garcia, Luis A. Studies on coffee root disease in Puerto Rico. I. A coffee *Fusarium* wilt. Jour. Agr. Univ. Puerto Rico **29:** 1–29. *f. 1–6 + tables 1–6.* Ja 1945.

Brun, Jacques. La maladie de Sigatoka ou Cercosporiose du Bananier. Revue Mycologie **12:** suppl. colonial 71–83. *f. 1–3.* 1947 [1948].

Burchfield, H. P. & McNew, G. L. Quantitative determination of tetrachloro-p-benzoquinone on treated seed. Phytopathology **38:** 298–306. *f. 1 + tables 1–3.* Ap 1948.

DeSantis, Mateo A. Lagarta rosada *Platyedra gossypiella* en capsulas de palo borracho. Revista Invest. Agr. [Buenos Aires] **1:** 287–290. *f. 1, 2.* O 1947.

Henry, B. W. & Andersen, A. L. Sporulation by *Piricularia oryzae.* Phytopathology **38:** 265–278. *f. 1–4 + tables 1, 2.* Ap 1948.

Holmes, F. O. *et al.* Low temperature as a factor in the germination of dwarf bunt chlamydospores. Phytopathology **38:** 309–312. *table 1.* Ap 1948.

Marsden, David H. A *Valsa* associated with *Cytospora* canker of spruces. Phytopathology **38:** 307, 308. Ap 1948.

Sarasola, J. A. & Campi, M. D. Reaccion de algunas cebadas con respecto a *Rhynchosporium secalis* en Argentina. Revista Invest. Agric. [Buenos Aires] **1:** 243–260. *pl. 1–3.* O 1947.

Takahashi, William N. Crystallization of squash mosaic virus. Amer. Jour. Bot. **35:** 243–245. *f. 1–3.* Ap [My] 1948.

Takahashi, William N. & Rawlins, T. E. An electron microscope study of tobacco mosaic virus extracted from pulp and juice after various periods of infection. Phytopathology **38:** 279–282. *table 1.* Ap 1948.

Wagener, Willie W. Diseases of cypresses. Part II of The New World Cypresses. El Aliso 1: 253–308. *f. 38–46.* 10 Ap 1948.

Wernham, C. C. The species value of pathogenicity in the genus *Xanthomonas.* Phytopathology 38: 283–291. *table 1.* Ap 1948.

Wolf, Frederick T. & Wolf, Frederick A. A toxic metabolic product of *Fusarium oxysporium* var. *nicotianae* in relation to a wilting of tobacco plants. Phytopathology 38: 292–298. Ap 1948.

MORPHOLOGY

(including anatomy & cytology in part)
(See also under Plant Physiology: King)

Dittmer, Howard J. A comparative study of the number and length of roots produced in nineteen angiosperm species. Bot. Gaz. 109: 354–358. 26 Mr 1948.

Hall, John W. A morphoplastic interpretation of the amphivasal bundle in *Ranunculus.* Lloydia 10: 235–241. *f. 1 + table 1.* D 1947 [Ap 1948].

Mahabalé, T. S. Prothalli of *Ceratopteris thalictroides.* Bot. Gaz. 109: 349–354. *f. 1–.9.* 26 Mr 1948.

Milanez, F. R. Anatomia das madeiras. Rodriguésia 10[20]: 111–119. D 1946 [1947].

Milanez, F. R. Canais secretores do Marupá. Rodriguésia 10[20]: 13–40. *pl. 1–12 + f. 1–6.* D 1946 [1947].

Milanez, F. R. Nota prévia sôbre os laticíferos de *Hevea brasiliensis.* Arq. Serv. Flor. [Rio de Janeiro] 2: 39–65. *pl. 1–5 + f. 1–10.* N 1946 [1947].

Miranda Bastos, Arthur. As madeiras do Pará; caracteres gerais e caracteres anatomicos. Arq. Serv. Flor. [Rio de Janeiro] 2: 157–182. *illust.* N 1946 [1947].

Mullendore, Naomi. Seedling anatomy of *Brachypodium distachyum.* Bot. Gaz. 109: 341–348. *f. 1–18.* 26 Mr 1948.

Pattee, S. M. Pollen of Iowa honey. Proc. Iowa Acad. 53: 175–177. *pl. 1.* 1947 [My 1948].

Swamy, B. G. L. The embryology of *Epidendrum prismatocarpum.* Bull. Torrey Club 75: 245–249. *f. 1–6.* 17 My 1948.

Van Fleet, D. S. Cortical patterns and gradients in vascular plants. Am. Jour. Bot. 35: 219–227. *f. 1–19 + table 1.* Ap [My] 1948.

Woodard, T. M. Difference in form and reaction to cold in root-tip and apical bud chromosomes of *Medeola.* Bull. Torrey Club 75: 250–255. *f. 1–7.* 17 My 1948.

Wylie, Robert B. Conduction in dicotyledon leaves. Proc. Iowa Acad. 53: 195–201. *f. 1.* 1947 [My 1948].

GENETICS

(including cytogenetics)
(See also under Spermatophytes: Cave & Constance; Dodds & Simmonds; under Plant Physiology: Darrow)

Burnham, C. R. Cytogenetic studies of a translocation between chromosomes 1 and 7 in maize. Genetics 33: 5–21. *f. 1.* 1948.

Christoff, M. & Christoff, M. A. Meiosis in the somatic tissue responsible for the reduction of chromosome number in the progeny of *Hieracium Hoppeanum* Schult. Genetics 33: 36–42. *f. 1, 2.* 1948.

Einset, John *et al.* Chimeral sports of apples. Jour. Hered. 38: 371–376. *f. 3–6.* 1947 [1948].

Heiser, Charles B. & Whitaker, Thomas W. Chromosome number, polyploidy, and growth habit in California weeds. Am. Jour. Bot. 35: 179–186. *f. 1–17 + tables 1–4.* Mr [16 Ap] 1948.

Smith, Luther. A haplo-viable deficiency-duplication from an interchange in *Triticum monococcum.* Bot. Gaz. **109:** 258–268. *f. 1–4.* 26 Mr 1948.

Toxopeus, H. J. Preliminary account on a new amphidiploid: *Solanum artificiale.* Genetica **24:** 93–96. 1947 [1948].

Walters, Marta Sherman & Gerstel, D. U. A cytological investigation of a tetraploid *Rhoeo discolor.* Am. Jour. Bot. **35:** 141–150. *f. 1–9 + tables 1–9.* Mr [16 Ap] 1948.

PLANT PHYSIOLOGY

Ajello, Libero. A cytological and nutritional study of *Polychytrium aggregatum.* Part II. Nutrition. Am. Jour. Bot. **35:** 135–140. *f. 1 + tables 1–5.* Mr [16 Ap] 1948.

Akamine, Ernest K. Germination of *Asystasia gangetica* L. seed with special reference to the effect of age on the temperature requirement for germination. Plant Physiol. **22:** 603–607. O 1947.

Asenjo, C. F. & Fernãndez, M. Del C. C. de. Uses, preparation, and properties of pinguinain, the protein-splitting enzyme of the Maya fruit. Jour. Agric. Univ. Puerto Rico **29:** 35–46. *f. 1–6 + tables 1–10.* Ap 1945.

Baker, Kenneth F. The coat-bound condition of germinating pepper seeds. Am. Jour. Bot. **35:** 192, 193. *f. 1.* Mr [16 Ap] 1948.

Brown, James W., & Mitchell, John W. Inactivation of 2,4-dichlorophenoxyacetic acid in soil as affected by soil moisture, temperature, the addition of manure, and autoclaving. Bot. Gaz. **109:** 314–323. *f. 1–5.* 26 Mr 1948.

Brunstetter, Byron C., *et al.* Mineral composition of bean stems treated with 3-indoleacetic acid. Bot. Gaz. **109:** 268–276. *f. 1–3.* 26 Mr 1948.

Brunstetter, Byron C. & Wiseman, Herbert G. Carotenoid pigments in tubers of the Katahdin variety of Irish potato. Plant Physiol. **22:** 421–437. *f. 1.* O 1947.

Cantino, Edward C. The vitamin nutrition of an isolate of *Blastocladia Pringsheimii.* Am. Jour. Bot. **35:** 238–242. *f. 1–5 + tables 1, 2.* Ap [My] 1948.

Chao, Marian Dellers. Growth of the dandelion scape. Plant Physiol. **22:** 393–406. *f. 1–6.* O 1947.

Crocker, William. Growth of plants; twenty years' research at Boyce Thompson Institute. *i–x,* 1–459. *f. 1–171.* New York, Reinhold. 1948.

Curtis, O. F. Distribution of rubber and resins in guayule. Plant Physiol. **22:** 333–359. *f. 1.* O 1947.

Danielson, L. L. Selectivity of 2,4-D and Sinox when applied to soil. Plant Physiol. **22:** 635, 636. *f. 1.* O 1947.

Darrow, George M. *et al.* Breeding of strawberries for vitamin C. Jour. Hered. **38:** 363–365. *f. 2.* 1947.

Decker, John P. The effect of air supply on apparent photosynthesis. Plant Physiol. **22:** 561–571. *f. 1–6.* O 1947.

Drosdoff, Matthew *et al.* Some effects of potassium deficiency on the nitrogen metabolism and oil synthesis in the tung tree (*Aleurites fordii*). Plant Physiol. **22:** 538–547. O 1947.

Dustman, R. B., Meade, R. C. & Fish, V. B. Pectic contents of apples in relation to thiocyanate sprays. Plant Physiol. **23:** 142–148. Ja 1948.

Edgerton, L. J. The effect of varying amounts of potassium on the growth and potassium accumulation of young apple trees. Plant Physiol. **23:** 112–122. *f. 1–3.* Ja 1948.

Emerson, Ralph & Cantino, E. C. The isolation, growth, and metabolism of *Blastocladia* in pure culture. Am. Jour. Bot. **35:** 157–171. *f. 1–9 + tables 1–5.* Mr [16 Ap] 1948.

Franco, C. M. & Loomis, W. E. The absorption of phosphorus and iron from nutrient solutions. Plant Physiol. **22:** 627–634. *f. 1–5.* O 1947.

Gawadi, A. C. The sugars of the roots of *Daucus carota*. Plant Physiol. **22:** 438–451. O 1947.

Giles, Norman H. & Lederberg, Esther Zimmer. Induced reversions of biochemical mutants in *Neurospora crassa*. Am. Jour. Bot. **35:** 150–157. *tables 1–10.* Mr [16 Ap] 1948.

Gustafson, Felix G. Distribution of thiamin and riboflavin in the tomato plant. Plant Physiol. **22:** 620–626. O 1947.

Hartmann, H. T. Some effects of temperature and photoperiod on flower formation and runner production in the strawberry. Plant Physiol. **22:** 407–420. *f. 1–3.* O 1947.

Heinze, P. H., Hayden, Frances R., & Wade, B. L. Vitamin studies of varieties and strains of peas. Plant Physiol. **22:** 548–560. *f. 1, 2.* O 1947.

Hodge, W. H. Distribución de alcaloides en la corteza de algunas Cinchonas peruanas. Bol. Mus. Hist. Nat. [Lima] **10:** 75–83. *tables 1, 2.* 1946.

Ivanoff, S. S. Chlorosis and nodulation of cowpeas as affected by trial sulphur applications to calcareous soil in the greenhouse. Plant Physiol. **23:** 162–164. Ja 1948.

Jorgensen, Carl J., & Hamner, Charles L. Weed control in soils with 2,4-dichlorophenoxyacetic acid and related compounds and their residual compounds under varying environmental conditions. Bot. Gaz. **109:** 324–333. *f. 1–4.* 26 Mr 1948.

King, Genevieve N. Artificial parthenocarpy in *Lycopersicum esculentum;* tissue development. Plant Physiol. **22:** 572–581. *f. 1–17.* O 1947.

Klose, A. A., Peat, Jean & Fevold, H. L. Vitamin C content of walnuts (Persian) during growth and development. Plant Physiol. **23:** 133–141. *f. 1–4.* Ja 1948.

Lambou, M. G. *et al.* A rapid method for the measurement of the inhibition of deterioration in intact seeds. Plant Physiol. **23:** 84–97. *f. 1–8.* Ja 1948.

Lepeschkin, W. Influence of temperature and light upon the exosmosis and accumulation of salts in leaves. Am. Jour. Bot. **35:** 254–259. *tables 1–6.* Ap [My] 1948.

Levitt, J. The thermodynamics of active (non-osmotic) water adsorption. Plant Physiol. **22:** 514–525. O 1947.

Loustalot, Arnaud J. *et al.* Influence of high, medium, and low soil moisture on growth and alkaloid content of *Cinchona ledgeriana*. Plant Physiol. **22:** 613–619. *f. 1–3.* O 1947.

MacGillivray, John H. Soluble solids content of different regions of watermelons. Plant Physiol. **22:** 637–640. *f. 1.* O 1947.

MacVicar, Robert & Tottingham, W. E. A further investigation of the replacement of boron by indoleacetic acid. Plant Physiol. **22:** 598–602. O 1947.

Meade, R. C., Fish, V. B. & Dustman, R. B. The determination of pectic materials in apples. Plant Physiol. **23:** 98–111. Ja 1948.

Miller, Erston V. & Schomer, Harold A. The effect of ultraviolet light on subsequent ripening of the fruit of the tomato (*Lycopersicon esculentum*). Plant Physiol. **22:** 608–612. O 1947.

Myers, Jack. Culture conditions and the development of the photosynthetic mechanism. V. The influence of the composition of the nutrient medium. Plant Physiol. **22:** 590–597. *f. 1, 2.* O 1947.

Nightingale, Gordon T. The nitrogen nutrition of green plants. II. Bot. Rev. **14:** 185–221. Ap 1948.

Pucher, George W. *et al.* Correction of data for protein nitrogen in leaves of *Bryophyllum calycinum.* Plant Physiol. **23**: 149–151. Ja 1948.

Pucher, George W. *et al.* Studies in the metabolism of crassulacean plants: The behavior of excised leaves of *Bryophyllum calycinum* during culture in water. Plant Physiol. **22**: 477–493. *f. 1–12.* O 1947.

Pucher, George W. *et al.* Studies in the metabolism of crassulacean plants: The diurnal variation in organic acid and starch content of *Bryophyllum calycinum.* Plant Physiol. **22**: 360–376. *f. 1–8.* O 1947.

Pucher, George W. *et al.* Studies in the metabolism of crassulacean plants: The effect of temperature upon the culture of excised leaves of *Bryophyllum calycinum.* Plant Physiol. **23**: 123–132. *f. 1–9.* Ja 1948.

Rasmussen, Lowell W. The physiological action of 2,4-dichlorophenoxyacetic acid on dandelion, *Taraxacum officinale.* Plant Physiol. **22**: 377–392. *f. 1–6.* O 1947.

Rice, Elroy L. Adsorption and translocation of ammonium 2,4-dichlorophenoxyacetate by bean plants. Bot. Gaz. **109**: 301–314. *f. 1–5.* 26 Mr 1948.

Riker, A. J. & Gutsche, Alice E. The growth of sunflower tissue in vitro on synthetic media with various organic and inorganic sources of nitrogen. Am. Jour. Bot. **35**: 227–238. *f. 1–12 + table 1.* Ap [My] 1948.

Säid, Husein & El Shishiny, E. D. Respiration and nitrogen metabolism of whole and sliced radish roots with reference to the effect of alternation of air and nitrogen atmospheres. Plant Physiol. **22**: 452–464. *f. 1–4.* O 1947.

Schatz, Albert & Plager, Hildegard. A search for virus inhibitors among soil Actinomycetes antagonistic to bacteriophages. Bull. Torrey Club **75**: 256–264. *f. 1 + tables 1–4.* 17 My 1948.

Scott, L. E. & Schrader, A. Lee. Effect of alternating conditions of boron nutrition upon growth and boron content of grape vines in sand culture. Plant Physiol. **22**: 526–537. *f. 1–3.* O 1947.

Sideris, C. P., Young, H. Y. & Chun, H. H. Q. Diurnal changes and growth rates as associated with ascorbic acid, titratable acidity, carbohydrate and nitrogenous fractions in the leaves of *Ananas comosus* (L) Merr. Plant Physiol. **23**: 38–69. *f. 1–5.* Ja 1948.

Smith, Frederick G. The effect of 2,4-dichlorophenoxyacetic acid on the respiratory metabolism of bean stem tissue. Plant Physiol. **23**: 70–83. *f. 1, 2.* Ja 1948.

Stocking, C. R. Recovery of turgor by cut shoots after wilting. Plant Physiol. **23**: 152–155. *f. 1.* Ja 1948.

Struckmeyer, B. Esther & MacVicar, Robert. Further investigations on the relation of photoperiod to the boron requirements of plants. Bot. Gaz. **109**: 237–249. *f. 1–29.* 26 Mr 1948.

Thimann, Kenneth V. Use of 2,4-dichlorophenoxacetic acid herbicides on some woody tropical plants. Bot. Gaz. **109**: 334–340. 26 Mr 1948.

Thimann, Kenneth V. & Bonner, Walter D. The action of tri-idobenzoic acid on growth. Plant Physiol. **23**: 158–161. *f. 1.* Ja 1948.

Tiffany, Lois. A method of producing stromata in *Claviceps.* Proc. Iowa Acad. **53**: 189, 190. 1947 [My 1948].

Tsui, Cheng. The role of zinc in auxin synthesis in the tomato plant. Am. Jour. Bot. **35**: 172–179. *f. 1–3 + tables 1–11.* Mr [16 Ap] 1948.

Viets, F. G., Whitehead, E. I., & Moxon, A. L. Nitrogen metabolism of detached corn leaves in darkness and in light. Plant Physiol. **22**: 465–476. *f. 1–6.* O 1947.

Walker, J. C. & Kendrick, J. B. Plant nutrition in relation to disease development. IV. Bacterial canker of tomato. Am. Jour. Bot. **35:** 186–192. *tables 1–6*. Mr [16 Ap] 1948.

Warburg, Otto. Assimilatory quotient and photochemical yield. Am. Jour. Bot. **35:** 194–204. *f. 1–6 + tables 1, 2*. Mr [16 Ap] 1948.

Weaver, Robert J. Contratoxification of plant growth-regulators in soils and on plants. Bot. Gaz. **109:** 276–300. *f. 1–11*. 26 Mr 1948.

Wilson, Charles C. Diurnal fluctuations of growth in length of tomato stem. Plant Physiol. **23:** 156–158. Ja 1948.

Wilson, Charles Christopher. The effect of some environmental factors on the movements of guard cells. Plant Physiol. **23:** 5–37. *f. 1–12*. Ja 1948.

Wilson, Charles C. The porometer method for the continuous estimation of dimensions of stomates. Plant Physiol. **22:** 582–589. *f. 1–4*. O 1947.

Winokur, Morris. Photosynthesis relationships of *Chlorella* species. Am. Jour. Bot. **35:** 207–214. *f. 1A, 1B + tables 1–5*. Ap [My] 1948.

Withrow, Alice P. & Withrow, Robert B. Plant growth with artificial sources of radiant energy. Plant Physiol. **22:** 494–513. *f. 1–5*. O 1947.

GENERAL BOTANY
(including Biography)

Bean, Ralph C. John Crawford Parlin [1863–1948]. Rhodora **50:** 130, 131. My 1948.

[**Hart, Helen**] Gordon Alexander Scott. May 7, 1895–February 28, 1946. Phytopathology **38:** 330. Ap 1948.

[**Hart, Helen**] Grover H. Burnett. January 31, 1890–June 15, 1946. Phytopathology **38:** 326. Ap 1948.

[**Hart, Helen**] John Leonard Rue. July 15, 1900–February 9, 1946. Phytopathology **38:** 329. Ap 1948.

[**Hart, Helen**] Joseph Hunter Gooding, Jr. August 31, 1891–April 14, 1947. Phytopathology **38:** 327. Ap 1948.

[**Hart, Helen**] Robert Almer Harper. January 21, 1862–May 12, 1946. Phytopathology **38:** 328. Ap 1948.

Merrill, Elmer D. C. S. Rafinesque, with notes on his publications in the Harvard Libraries. Harvard Lib. Bull. **2:** 5–21. 1948.

Moldenke, Harold N. Harold Norman and Alma Lance Moldenke—Autobiographical sketches. Plant Life **2:** 9–12. *pl. 1, 2*. 1946 [1948].

Moldenke, Harold N. & Alma L. A brief historical survey of the Verbenaceae and related families. Plant Life **2:** 13–98. *pl. 2–9*. 1946 [1948].

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REGENERATION IN THE MEGAGAMETOPHYTE OF ZAMIA FLORIDANA[1]

CARL D. LARUE

Apogamy and apospory, in the Bryophyta and the Pteridophyta, have been under investigation for a long time and have engaged the attention of numerous workers (6). Apospory in mosses has often been found occurring naturally, and has been induced in numerous species by several workers. Apparently, apogamy has been reported in only one species of moss, *Phascum cuspidatum* (6). Apospory and apogamy have been reported in a number of species of ferns and Jeffrey (4) found evidence of apogamy in *Botrychium virginianum* in the presence of tracheids in the gametophyte. In his paper on the gametophyte of *Botrychium virginianum* Jeffrey suggests also that it would be interesting to know whether apogamy occurs in the cycads. Indeed, it seems that the studies in the Bryophyta and Pteridophyta lead logically to an investigation of the possibility of inducing apogamy in the Gymnospermae, but, apparently, no one had embarked upon it, until, some years since, the writer began to investigate regeneration in the megagametophyte of *Zamia floridana*. Later he discovered that Duchartre (1) had described the production of roots on gametophytes of *Cycas Thouarsii* R.Br. which were without embryos and had lain overlong in the germination bed. This observation was made too early for Duchartre to understand its full significance and until this time it has remained practically unnoted by others.

Methods. Fresh cones of *Zamia floridana* were secured from Florida and the ovules were cultured on nutrient solutions in screw-capped glass bottles. The ovules were sterilized for 20 minutes in a 20 per cent solution of commercial "Clorox" or of "Roman Cleanser." They were opened with a sterile knife and the gametophytes were lifted out and laid on the surface of nutrient agar. Early stages of ovule development offered no difficulty in the removal of the integument but the stony layer of the integument of ripe seeds made the removal of the gametophytes very difficult They were best treated by removing all the fleshy layer and allowing the stony layer to dry until it could be cracked open. The parchment-like nucellus was then removed and the gametophyte sterilized and cultured.

[1] Paper No. 762 from the Department of Botany, University of Michigan. A portion of this work was done at the University of Michigan Biological Station. This research was aided by a grant from the Horace Rackham Research Fund. Thanks are due to Professor F. W. Weber of the University of Florida for furnishing ovules of *Zamia floridana*.

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Gametophytes of various ages were tried, from very early stages to those of ripe ovules. Halves of gametophytes, quarters, and smaller pieces of various dimensions were put in culture.

For the greater number of the cultures White's solution (7) was used, commonly with 0.8 to 1 per cent agar-agar, although trials were made without agar-agar. In recent trials with young gametophytes the tobacco and sunflower media of Hildebrandt, Riker and Duggar (3) were used. Some cultures were made without any minerals.

Sucrose and dextrose were used in culture solutions in concentrations ranging from 1 to 10 per cent, but trials were made without any sugar.

The cultures were kept at ordinary room temperature. Some were exposed to weak light in the laboratory; some to north light near a window; some were placed in full light in a greenhouse, and some in total darkness.

Results. *Effects of cultural conditions.* It cannot be stated that any particular nutrient solution, or any method of treatment has been of special importance. Gametophytes excised at the fertilization stage, or later, are densely packed with starch and it is not surprising that an addition of sugar is not needed. There is no evidence that additions of minerals are needed either, but an adequate water supply is essential.

For young gametophytes sugar and minerals may be needed, but so little success has been obtained in growing them that no conclusions should be drawn.

The cultures seem indifferent also to the presence or absence of light.

Growth. Very young gametophytes grew very little and soon perished. Those transferred to culture about one month before the fertilization stage usually doubled their original size. Those transferred at the fertilization stage, or later, grew slowly and steadily for a long time. Eventually many of them reached a volume 4 or 5 times that which they processed at the time of transfer. Whether the growth was due merely to increased cell size, to augmented numbers of cells, or to both, has not been determined.

Small pieces of gametophyte usually died very soon, and nothing like a continuing tissue culture has been developed.

Differentiation. Many specimens showed no change in appearance save that of increased size. A very few developed chlorophyll in their superficial layers after long exposure to weak light. Exposure to direct sunlight did not stimulate chlorophyll formation in a higher percentage of gametophytes than north light in the laboratory. Chlorophyll had no apparent effect on either growth or regeneration.

Cork formation. Approximately one half the gametophytes showed extensive formation of cork. This appeared first in the form of pustules resembling intumescences and sometimes proceeded no further. But in most

instances the process went on until the gametophyte was covered almost completely by loose periderm which turned brown with age.

Microtome sections of gametophytes show that the periderm is not confined to the surfaces but that plates of this tissue may be formed in successive layers inward almost to the center of the structures. The process of periderm development is very similar to that in the endosperm of *Crinum* as described by Merry (5), but in *Crinum* periderm is formed only under superficial layers of cells.

Endosperm cells. At the fertilization stage and at all later stages the cells of *Zamia* gametophyte are closely packed with starch grains. After long growth in vitro these starch grains have disappeared from the cells except those which lie in islands isolated by sheets of periderm. These latter cells are as full of starch as they were at the beginning of the culture. Otherwise, maintenance in culture produces no obvious change in gametophytic cells.

Regeneration. Regeneration has been most frequent in endosperms excised from ovules at about the fertilization stage. Later stages of gametophytes up to those from fully ripe ovules have not regenerated at all. Young ovules, approximately two months before fertilization, have yielded gametophytes which occasionally have produced buds in the remarkably short time of three months. Ovules excised a month later have formed roots and buds within five months. Gametophytes excised at or near the fertilization stage have required approximately a year to form roots or shoots.

The percentage of gametophytes which have formed roots, shoots, or both, has been very small. An exact count has not been made but probably less than one gametophyte in a hundred has shown regeneration. This estimate considers the gametophytes alive and healthy at the end of a year's growth in culture.

The regenerated structures appeared at first as a pustular mass on the surface of the gametophyte. These arose at random, apparently, on any part of the gametophyte except that they were decidedly more common in a ring around the pore from which the root of the seedling would emerge upon germination.

Although most outgrowths appeared on the uninjured surface of the gametophyte they were seen to arise also on the surfaces of cuts on halves of gametophytes.

Microscopic sections of the early primordia of roots and shoots show masses of meristematic cells not yet definitely organized. These are inconspicuous and may have developed on many gametophytes where they were not detected.

With further development, the outgrowths could be identified as roots

FIG. 1. Bud formed on one-half a megagametophyte of *Zamia floridana*. FIG. 2. Regenerated root and shoot on a gametophyte of *Zamia*. Note the resemblance of the miniature leaves to the leaves of normal *Zamia* seedlings.

or shoots. In one example a short axis grew out from the gametophyte and then formed a bud above and a root below, thus showing a marked resemblance to a *Zamia* seedling in miniature. In all others, roots and shoots arose separately.

Thus far, no regenerated roots have continued growth, nor elongated more than a few centimeters. None of them has produced any secondary roots. Primary roots on *Zamia* seedlings usually elongate considerably before forming secondary roots, and it may be that regenerated roots possess this characteristic of the species.

When the shoot primordia grew out they were seen to be very like seedling stems of *Zamia*, but of much smaller size. Obviously they are sporophytes which have been formed from gametophytes. Figure 2 shows the best specimen yet produced.

No regenerated plant has yet been grown beyond the stage shown in figure 2. This is probably due to the lack of root connection. Not one has lived long enough to form adventitious roots and only the one mentioned above has had a root and a shoot produced from the same bud and that one died. It is still hoped that others like this one, or with a root and a shoot produced alongside, so that a root-shoot axis may be formed, will arise and prove capable of growth to eventual maturity.

There is no possible doubt that these regenerates were formed apogamously from gametophytic tissue. Therefore, it may be assumed that they are haploid in chromosome constitution, although this is not necessarily true, and the chromosome number has not yet been determined. It is hoped that material suitable for chromosome counts will be produced in the near future.

Microscopic examination of the connection between shoots and gametophytes shows definite continuation of tissues from one structure into the other. What is most surprising is to find that the tracheids of the xylem of the stem extend deep into the gametophyte, a structure in which no tracheids have ever been found before. The bundle of tracheids ends blindly in the gametophyte. The phloem could not be traced into the gametophyte.

Discussion. This investigation carries into the Gymnospermae the principle, that, in plants showing alternation of generations, one generation can be secured (sometimes) by regeneration from the alternate generation. This principle has long been established in the Bryophyta and the Pteridophyta, but apparently it rarely has been suggested that it might apply to the Gymnospermae as well. In the Bryophyta, except in one species, regeneration only of the gametophyte from the sporophyte has been obtained; exactly the reverse of the condition of *Zamia*. In the Pteridophyta, regeneration both of gametophyte from sporophyte, and sporophyte from gametophyte has been observed, either occurring naturally or under ex-

perimental conditions (6). Presumably, it is not to be hoped that in *Zamia*, the gametophyte can be regenerated by the sporophyte and it is rather startling that the undifferentiated gametophyte can form, by a process of regeneration, so complex a structure as the sporophyte of a seed plant. Of course, until the haploid constitution is proved for these regenerated structures, the possibility remains that some process of diploidization has taken place, and with that, the formation of all the controls which lead to development of a normal sporophyte from a fertilized egg.

Once the gametophyte has given rise to the root and shoot primordia it may not be considered surprising that these structures are able to act as sources of organization in the gametophyte itself. In the Bryophyta regeneration leads to the simpler of the generations, the gametophyte, and one would scarcely expect the gametophyte to induce any change in the sporophyte.

In fern gametophytes which have formed sporophytes apogamously tracheids have been found; a correlation first observed by Farlow (2). The formation of the tracheids may be attributed to some influence of the apogamous sporophytes which have a closer connection to the gametophyte than normal sporophytes, developed from fertilized eggs in the archegonia. Tracheids have been found in some aposporous gametophytes, and in these too, there is a direct connection with the parent sporophyte. The presence in aposporous gametophytes of other structures normally sporophytic (stomata and sporangia) may also be due to influences of the sporophytes from which they grew.

The development of tracheids in the gametophyte itself resembles the extension of vascular strands in a mass of callus with an adventitious bud on its surface. However, in the callus, there may be question as to whether the stimulus to differentiation came from the bud or from the normal vascular strands in the stem which has produced the callus. In the *Zamia* gametophyte there was no antecedent stem structure to serve as a source of the stimulus and therefore it appears that the stimulus, or organizer, whatever its nature may be, came from the bud. Or it may be that conditions which led the gametophyte to form a bud were themselves the stimulus to tracheid formation deeper in its tissues. It is truly remarkable that an undifferentiated tissue, given a considerable amount of time, freedom from decay by bacteria and other fungi, an abundant supply of food and water, and totally removed from any contact with its mother plant, should be able to develop such diverse structures as phellogen, root and stem meristems, and tracheids. The structures concerned cannot be atavistic since we are dealing with a gametophyte, and no gametophyte has ever been found which bore true roots and leaves. Whence comes the pattern of differentiation?

SUMMARY

1. Gametophytes of *Zamia floridana* were removed from ovules of various stages of development and maintained as cultures, usually on agar.

2. Little growth was obtained from stages earlier than that of fertilization.

3. Gametophytes beyond the fertilization stage increased their volume five-fold.

4. The cultured gametophytes seemed relatively indifferent to concentrations of minerals and sugar, and even to presence, or absence, of minerals, sugar, and light. A supply of water and freedom from contaminating organisms were essential.

5. Cork development was very extensive on many gametophytes.

6. Regeneration occurred, but in less than one per cent of the cultures.

7. Roots were produced but these did not continue growth, nor produce secondary roots.

8. Buds were formed which produced leaves strongly resembling miniatures of normal seedling leaves.

9. Bundles of tracheids extended from the buds into the gametophyte, where they ended blindly. Apparently the buds stimulated the transformation of gametophytic cells into tracheids.

10. This study extends to the Gymnospermae the principle that, in plants possessing an alternation of generations, one generation may be derived from the other by regeneration.

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Literature Cited

1. **Duchartre, M. P.** 1888. Note sur l'enracinement de l'albumen d'un *Cycas*. Bull. Soc. Bot. Fr. **35**: 243–251.
2. **Farlow, W. G.** 1874. An asexual growth from the prothallus of *Pteris cretica*. Quart. Jour. Micr. Sci. **14**: 266–272.
3. **Hildebrandt, A. C., Riker, A. J. & Duggar, B. M.** 1946. The influence of the composition of the medium on growth in vitro of excised tobacco and sunflower tissue cultures. Am. Jour. Bot. **33**: 591–597.
4. **Jeffrey, E. C.** 1896. The gametophyte of *Botrychium virginianum*. Univ. Toronto Bot. Stud. Biol. Series **1**: 1–32.
5. **Merry, J.** 1936. Formation of periderm in the endosperm of *Crinum asiaticum*. Pap. Mich. Acad. **32**: 159–164.
6. **Steil, W. N.** 1939. Apogamy, apospory and parthenogenesis in the pteridophytes. Bot. Rev. **5**: 433–453.
7. **White, P. R.** 1934. Potentially unlimited growth of excised tomato root tips in a liquid medium. Plant Physiol. **9**: 585–600.

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THE BLACK ASPERGILLI IN RELATION TO CELLULOSIC SUBSTRATA[1]

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INTRODUCTION

The most recent revision (Thom & Raper 1945) of the genus *Aspergillus* presents the following scheme of classification of the forms having enough dark coloring matter to be popularly referred to as the black group.

Aspergillus niger series
- *A. foetidus* Thom & Raper
- *A. awamori* Nak.
- *A. miyakoensis* Nak., Simo, & Watan.
- *A. niger* v. Tiegh.
- *A. niger* mut. *cinnamomeus* (Schiem.) Thom & Raper
- *A. niger* mut. *Schiemannii* (Thom) Thom & Raper
- *A. Phoenicis* (Corda) Thom & Currie
- *A. pulverulentus* (McAlp.) Thom & Currie

Aspergillus carbonarius series
- *A. atropurpureus* Zimm.
- *A. fumaricus* Wehm.
- *A. Fonsecaeus* Thom & Raper
- *A. carbonarius* (Bain.) Thom

Aspergillus luchuensis series
- *A. luchuensis* Inui
- *A. japonicus* Saito
- *A. violaceo-fuscus* Gasp.

Many hundreds of papers have been written on the nutrition and biochemical activity of these forms, which commonly are designated loosely as "*Aspergillus niger.*" However, no detailed consideration has been given to the question of their ability to hydrolyze cellulose and utilize the products as carbon sources, and no mention at all has been made of the behavior of the individual species in this connection. Those papers which have touched upon the subject have come mostly from the textile industry, and the references have been incidental to the main theme. This, together with the non-exacting use of the name "*A. niger*" to cover the whole range of morphological and physological forms found in the black group has resulted in an accumulation of brief, widely scattered, inconclusive, and con-

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tradictory statements concerning the relationship of "*A. niger*" to cellulosic substrata.

During the period of 1940 to 1945 there was widespread use of strains of the *A. niger* group by both government and commercial laboratories in this country, and to a lesser extent those of the British Empire, as a test organism for the assessment of mold-proofness in a great variety of manufactured products, especially those intended for military use in the tropics. For testing cotton fabrics they were used alone or supplemental to such universally employed and strongly cellulolytic species of fungi as *Chaetomium globusum* Kunze and *Myrothecium verrucaria* (Alb. & Schw.) Ditm. ex Fr. (= *Metarrhizium glutinosum* Pope). For the testing of plastics, leather, paper, paint, glue, etc., and the many combinations of such component materials that go into the makeup of completed items like coated fabrics, radio sets, electrical apparatus, optical equipment, and packaging materials they were used alone or perhaps more often in combination with other molds.

There was a general feeling on the part of those charged with the responsibilities of procurement testing, and of those engaged in the development of test methods, that "*A. niger*" was one of the organisms that should be employed. The reasons for its selection were the frequency with which such forms were isolated from a wide range of decomposing materials and their presumably high relative tolerance to fungus-inhibiting chemicals. The fact of strain differences was well known, but there was no data at hand to indicate a choice of one strain as superior to another for the particular type of material to be tested. This was a subject for debate and discussion at many conferences, and pertinent notes have appeared in numerous mimeographed military and commercial reports. But because of the limited investigations that could be carried out during wartime on the nature and activities of the organisms themselves, there are still almost no data on the relative adaptability of strains to testing procedures.

Certain groups of workers selected the culture designated as TC *215–4247* for the sake of standardization, and others followed suit. This strain was the basis of a well known long series of nutritional studies by Dr. R. A. Steinberg begun in 1918 and continued to the present time. The selection was not made on the basis of any demonstrated superiority of this strain over others. Rather, the reasoning was to the effect that in the absence of any information on strain adaptation for the specific purpose, it was desirable to choose a strain having a long pure-culture history and whose cultural stability and nutritive requirements were well established. The strain, TC *215–4247*, represents ***Aspergillus niger*** **v. Tiegh.** ***sensu strictu.***

For the most part, those not employing TC *215–4247* used Australian

Mycological Panel serial number *26*. This was isolated at Sydney about 1943 from a wireless set stored there in a test chamber and was recommended by the Australian workers for inclusion in a "mold mixture for the testing of electrical equipment, paper, etc." Thus far it appears not to have been identified any more precisely than as a member of the *A. niger* group.

A fundamental consideration in the wartime discussions and reports (mostly unpublished) concerning the use of "*A. niger*" in testing procedures had to do with the question of whether or not it was capable of degrading cellulose. In the practical selection of test organisms for leather products, paint, and the like, this question is, of course, irrelevant. But with cellulose in some form being an ingredient of so many items, the question would appear to be a basic one in the selection of test strains either for cotton fabrics or for broad general use.

The purpose of this paper is to resolve the question of cellulose decomposition by the black *Aspergilli;* to determine whether positiveness and negativeness of cellulolytic activity, if both are found to exist, correlate with the current taxonomy of the group; to present a summary of studies on their behavior toward cellulosic fabrics and similar materials in the field; and to offer suggestions which may be of eventual value in the selection of strains for use in the testing of mold-proofness of cotton fabrics and other cellulosic materials.

LITERATURE REVIEW

The pertinent literature may be broken down to three convenient and more or less distinct categories: (1) decomposition of cellulose, (2) field and storage damage to fabrics, and (3) use in assessment testing.

Decomposition of Cellulose. The controversy concerning cellulolytic action of "*A. niger*" is not of recent origin. Van Iterson (1903) noted that the "quantity or nature" of the cellulolytic enzyme secreted by the various species of molds varied considerably as evidenced by great differences in destructive power. As a result of growth on paper discs and dissolution of cellulose in paper pulp cultures, he grouped twenty species as powerful, moderately strong, weak and negative. Among the weak was "*A. niger.*" Scales (1915) reported it capable of utilizing the reprecipitated cellulose of filter paper, as indicated by a zone of clearing. Gerry (1923), in an investigation of the effects of hyphomycetous molds on wood designated for exacting purposes in World War I, found that in long pure-culture tests on wood blocks the hyphae grew in the cell cavities and passed from cell to cell through natural openings, not penetrating the lignified cellulose of the cell walls. There was little or no damage beyond the production of a surface discoloration. The implication was that the organism did not break down

lignified cellulose. Paine (1927), working in Iowa, tested an isolate from local soil by attempting to grow it on cotton batting, absorbent cotton, and filter paper when these were partially immersed in a mineral salts solution. The results were negative. About the same time Thaysen and Bunker (1927), briefly reviewing the earlier literature, confined themselves to the conservative conclusion that "*A niger*" was "frequently encountered wherever cellulose decays." Galloway (1930), in a general treatment of the fungi that were found troublesome to the British cotton industry, tested one strain for cellulolytic activity, and rated it as "moderate" on the basis of the amount of visible growth produced on filter paper on a mineral salts agar. This was considered an indication, though not an infallible criterion of the ability of the organism to tender cloth by decomposing the cellulose. In a pure culture test on cotton yarn, "*A. niger*" was stated to have brought about a decline in tensile strength, while *A. Sydowi* and *Rhizopus nigricans* gave negative results. Norman (1930) worked with several organisms, including "*A niger*," in relation to the decomposition of straw and referred to the lot categorically as cellulose destroyers, but seemingly did not prove actual cellulolytic action for any of them. Klemme et al. (1945) tested the activity of a considerable number of isolates of various Fungi Imperfecti on cotton duck in the presence of a mineral salts solution and recorded results in breaking strength ranging "from 97 per cent for one strain of *Metarrhizium glutinosum* to no loss for *Aspergillus niger*." The strain of *A. niger* used was the TC *215–4247* previously discussed. Marsh et al. (1945) made reference to copper tolerance of *A. niger*, presumably based largely on tests of TC *215–4247*, and noted that several isolates which they had used in experiments had failed to decompose cellulose.

The foregoing records add up to four positive, four negative, and two implying positivity for cellulolytic activity.

Early in the program of our own laboratory a system was set up for the routine testing for cellulolytic activity of molds which were being isolated from fabrics, etc. exposed in the tropics. Thirty-one strains of black *Aspergilli* were included in these tests (White, Darby et al. 1948). A decline in the strength of strips of grey cotton duck or of a more highly purified bleached sheeting in the presence of the mineral salts medium[4] recommended by Greathouse, Klemme, and Barker (1942) was taken as a measure of cellulolytic activity. Some strains were tested on both kinds of cloth and by several minor variations in the basic method, using, however, the same mineral salts formula throughout. All strains except two, JQMD *745* and PQMD *23b*, gave clearly negative results, and these two strains, under

[4] Composition in grams per liter: K_2HPO_4, 1.3940; $MgSO_4 \cdot 7H_2O$, 0.7395; NH_4NO_3, 1.0006; $CaCo_3$, 0.005; NaCl, 0.005; $Fe_2(SO_4)_3 \cdot 7H_2O$, 0.001; $MnSO_4$, 0.001; initial pH 6.8.

the conditions of the tests, proved to be active only on the duck. After the discovery of their cellulolytic activity they were examined more thoroughly and found to be members of the *A. luchuensis* series. They were recorded in the previous paper as *A. luchuensis* Inui. Another strain (PQMD *124g*) recorded as *A. japonicus* failed to break down bleached cotton sheeting and was not tested on grey duck. The remaining 28 isolates, including Australia *26* to which reference was made on a previous page, were clearly all inactive. They were identified only as members of the *A. niger* group as that group was treated by Thom and Raper (1945); none of them were members of the *A. luchuensis* series. In another experiment carried out in this laboratory in a study of methods (Reese 1947), negative results were obtained when JQMD *745* (under the name *A. niger*) was incubated in a ground filter paper–mineral salts solution in shaker flasks. The method proved highly conducive to cellulolytic action of known cellulose destroyers which were run in parallel series. Siu (1947), on the basis of unpublished work to be reported in detail in the present paper, made brief reference to yeast extract as a requirement for cellulolytic activity of culture JQMD *745* (also referring to it as *A. niger*).

Field and Storage Damage to Fabrics. Dorée (1923) reported isolation of "*A. niger*" from hemp in the Philippines, the material showing a large percentage of brittle and discolored fibers. In inoculation tests it proved to be damaging to the poorer grades of hemp but scarcely so to Grade A material. The explanation was that its nourishment was mainly from the starch content of the pulp remaining in the low grade material. Armstead and Harland (1923), found the organism mainly responsible for mold in loin cloths manufactured in England and transported to India to be "an *Aspergillus* of the *niger* group." The illustrations make it clear that they were working with a strain or strains other than of the *luchuensis* series. No reference was made to any actual deteriorative action against the cellulose, but emphasis is laid on its ability to cause objectionable growth and staining and to attack unsized weft threads even though the warp sizing contained a "full quota of antiseptic." Bright, Morris, and Summers (1924), in a generalized account of mold problems in the British cotton industry, stressed the importance of *Penicillium, Mucor,* and *Aspergillus,* especially "*A. niger,*" but indicated that while most common they were less apt to tender. It was stated, however, that as of that date there was little or nothing known of ability of such forms to tender, i.e., actually decompose, the cellulose of the fibers. Reiners (1924) stated that at low moisture content the molds most apt to develop were species of *Aspergillus,* of which "*A. niger,*" was one of the first to appear. He noted that molds were least troublesome in unsized fabrics and emphasized control through use of antiseptics in sizing. Bright (1926) in a study of staining and swelling techniques to

be used as criteria of types of damage to cotton fibers, attempted to produce fungal damage experimentally by inoculating with spores sterilized fibers moistened with distilled water. "*A. niger*" was one of two fungi employed. Fibers inoculated with the organism were said to be degraded on the basis of the Congo red test, while they doubtfully passed the swelling test as undamaged. In contrast, the second fungus, not named but said to be a strong cellulose destroyer, did obvious damage with either test as a criterion. The reader is left somewhat puzzled as to whether the *Aspergillus* did or did not damage the fibers. Galloway (1930) noted that "*A. niger*" was one of the most commonly encountered molds in the whole make-up process from the boll in the field to shipping of the finished fabric where it grew in the starchy sizing material, vigorously producing acids and causing objectionable staining. Galloway (1931) used "*A. niger*" as one of several test organisms with which he was able to experimentally produce "diamond spot" in cotton cloth.

Use in Assessment Testing. Black *Aspergilli* have been employed in the assessment testing of fabrics by a number of methods with and without an accessory carbon source. No attempt will be made to evaluate these methods, but some are mentioned as a matter of interest. Marsh et al. (1944) made successful use of strain TC *215–4247* for the assessment of fungus resistance of cotton fabrics by a method employing a small amount of accessory carbon in the mineral solution. He noted that the organism was "not a true cellulose destroyer" and that it was highly copper-tolerant. Spores planted on strips of fabric treated with copper tallate or copper oleate produced bleached zones in which the copper had been solubilized by the fungus. In the same year, Bertolet (1944) stressed the need for testing fabrics for resistance "not only to cellulose decomposing organisms but also to superficial organisms such as *Aspergillus niger*. . . ." A paper prepared by an AATCC Subcommittee on Mildew Proofing (1945) indicated methods for the use of TC *215–4247* in cotton fabric assessment testing by the addition of a small amount of other carbon sources to the mineral salts medium so that the organism is not dependent upon the cellulose of the fabric for its carbon nutrition. Bayley and Weatherburn (1945), referring to strain TC *215–4247* as a surface grower, found it considerably more tolerant to copper naphthenate than the well known cellulose destroyers ***Chaetomium globosum***, USDA *1042.4*, or ***Myrothecium verrucaria*** (= ***Metarrhizium glutinosum***), USDA *1334.2* on the basis of visual growth on copper-naphthenate-impregnated bleached and purified cotton sheeting incubated on a mineral salts agar. The *A. niger* was said to have produced a heavy growth, equally good at all concentrations of copper tried, i.e., 0.005 to 0.8 per cent metallic copper on the weight of the fabric, whereas the other organisms were nearly or completely inhibited at the higher concentrations. The source

of carbon necessary for the reported heavy growth must stand as something of mystery. Scribner & Abrams (1946) found "*A. niger*" to appear to some extent on kraft paper and its associated cementing and strengthening materials exposed in a "tropical" test chamber in Washington, D. C., and used strain TC *215–4247* for pure culture tests of such materials by growing the organism on a mineral salts agar containing 30 grams of sucrose and incubating the paper or other material on the already formed mycelial mat.

Incidental mention may be made at this point of a few of the more recent papers in which reference is made to "*A. niger*" for the testing of mold-proofness of materials of composition primarily other than natural cellulose (Appling & McCoy 1945). Olson & Macy (1945) employed a strain in experiments in the control of surface growth on butter wrapped in sodium- and calcium-propionate-impregnated parchment; Titus (1945) made reference to its use for testing by the General Electric Company of plastics and cellulosic materials of electric apparatus; Brown (1946) used it for plastics; Kanagy et al. (1946) noted it as one of the principal forms developing on leather under various test conditions; and Lavers & Illman (1946) used it in a mold mixture for testing packaging material including those of cellulose and its derivatives.

In so far as can be determined, none of the strains employed in the published accounts of the assessment testing of materials, of whatever nature, have been members of the *A. luchuensis* series. Probably all of them represented *A. niger* in the narrow sense.

EXPERIMENTS

Experiment 1. Activity of Strains of the Aspergillus luchuensis Series on Grey Cotton Duck (figs. 1–3). Before the series of assays reported by White, Darby et al. (1948), culture JQMD *745* had been found capable of decomposing cellulose when tested on grey cotton duck by Dr. G. W. Martin at the Biological Laboratories of the Jeffersonville (Indiana) Quartermaster Depot, where the strain had been isolated. Following confirmation of this in our own laboratory, together with similar results with our own PQMD *23b*, it was thought desirable to determine whether or not cellulolytic ability was a characteristic of certain series or species of the black *Aspergilli* as this group had been treated taxonomically by Thom and Raper.

Of the several thousand cultures in our collection (excluding a set from Panama which has not yet been examined critically by the present writers), mostly isolated from military materials from the warmer parts of the world, a total of approximately eighty numbers had been carried in stock as members of the *A. niger* group. A thorough examination of these revealed ten as belonging to the *A. luchuensis* series and having morphological characters extremely close to those of JQMD *745* and PQMD *23b*. When grown

on potato dextrose agar in parallel series they exhibit minor differences in their gross aspect, as well as in microscopic characters, but are remarkably uniform in color of the fruiting surface, being almost precisely "bone brown" of Ridgway (1912). Such factors as age, temperature, and variations in substrata have no perceptible effect on color; and of the isolates of the *A. niger* group from military equipment which have thus far accumulated in our culture collection, the cellulolytic strains may easily be segregated from the non-cellulolytic ones by the color exhibited by the stock cultures, the cellulolytic ones being "bone brown," the non-cellulolytic strains in darker shades—more nearly black.

Seven of the "bone brown" cultures were selected for the following cellulolytic tests. In addition to these, culture TC *215–4247* was included because of its wide use in assessment and procurement testing. Three additional cultures identified only as members of the *A. niger* group (but not members of the *A. luchuensis* series) were selected at random for comparison. *Chaetomium globosum*, USDA *1042.4* was included for comparison because it has come to be recognized as a standard test strain and its strong cellulolytic activity is familiar to all who are interested in the microbiological decomposition of cellulose.

Test cloth was prepared by cutting twelve-ounce grey cotton duck into warp-wise strips 1¼ inches wide, further raveling to exactly 1 inch, then clipping to six-inch lengths. Such strips were then inserted 1 each in 20 × 200 mm. Pyrex test tubes of 75 ml. capacity each containing 25 ml. of Greathouse's formula A (see footnote 5) mineral salts solution. The tubes were then plugged with cotton and autoclaved at 15 lbs. pressure for 20 minutes. After cooling, 2 ml. of a spore suspension was distributed evenly over the upper (unsubmerged) half of the strip. The inoculum was prepared by growing the organisms on potato dextrose agar slants (2% dextrose) in 17 × 150 ml. test tubes under room conditions for 9 days (30 days for *Chaetomium globosum*). Approximately 20 ml. sterile distilled water was added to each tube, the spores loosened and brought into suspension by teasing with a pipette and made up to a volume of 32 ml. in a flask. This gave a fairly strong suspension. It has been shown by Greathouse et al. (1942) that within broad limits the concentration of spores makes but little difference except perhaps during the very early period of incubation. The tubes were then incubated in a room under conditions approximating 85° F and 80% relative humidity. At harvest the strips were removed, washed in 95% ethanol, then tap water, dried under room conditions, subjected to standard conditioning of 24 hours at 75° F and 65% relative humidity, and broken on the motor driven Scott tester with a three inch space between the jaws.

The results are presented in figures 1–3. The growth patterns and rela-

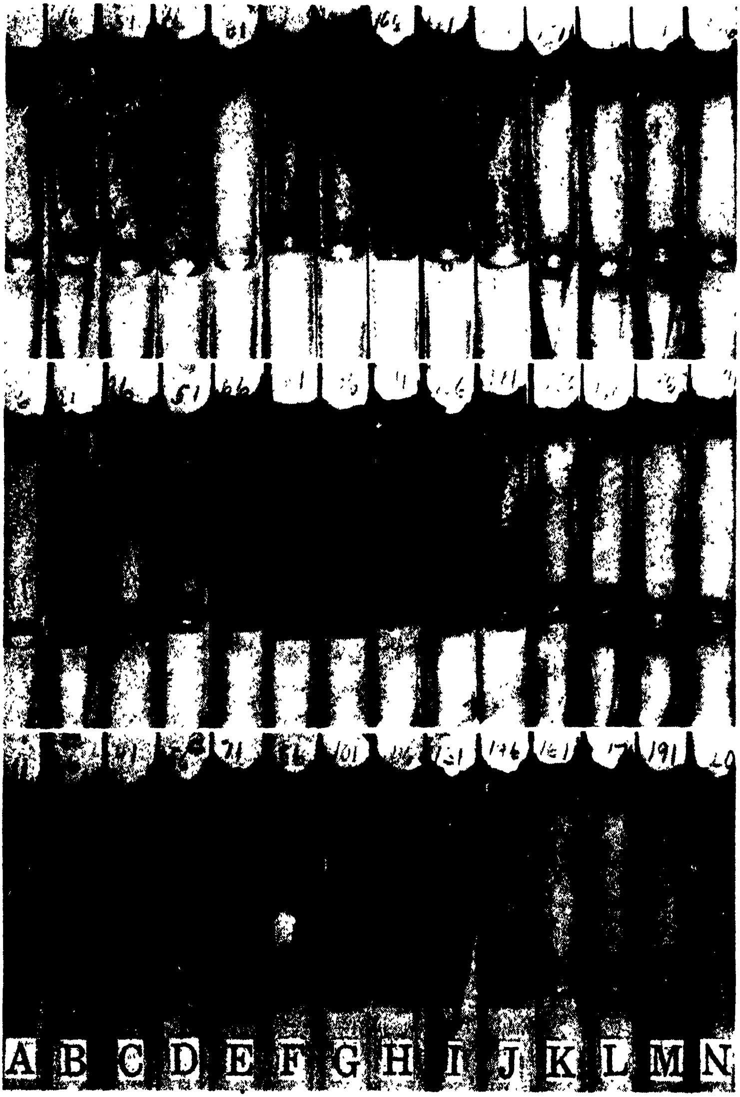


Figure 1

Growth of black *Aspergilli* on strips of grey cotton duck in test tubes. Each tube is representative of 5 replicates. Horizontal rows: top, 7 day harvest; middle, 14 day harvest; lower, 21 day harvest. Vertical rows: A, uninoculated controls; B, *Chaetomium globosum*, USDA *1042.2;* C–J, members of the *A. luchuensis* series: C, PQMD *21e;* D, PQMD, *23b;* E, PQMD *70c;* F, PQMD *102d;* G, PQMD *155e;* H, JQMD *190;* I, JQMD *228;* J, JQMD *745;* K–N, *A. niger* group other than *A. luchuensis* series: K, TC *215–4247, A niger sensu strictu;* L, PQMD *38b;* M, PQMD *154a;* N, PQMD *198b.* × slightly less than ⅓.

tive amounts of growth are indicated in the plates. The decline in tensile strength is indicated in figure 3 where the bars represent pounds strength retained on the basis of an average of 5 replicates.

As indicated in figure 3 all of the eight strains of the *A. luchuensis* series proved to be cellulolytic. The so-called official strain, TC *215–4247*, i.e., *A. niger* in the narrow sense, and three strains identified only as being in the *A. niger* group exhibited no action. All strains of the *A. luchuensis* series were weak in comparison with the powerful cellulose destroyer, *Chaetomium*

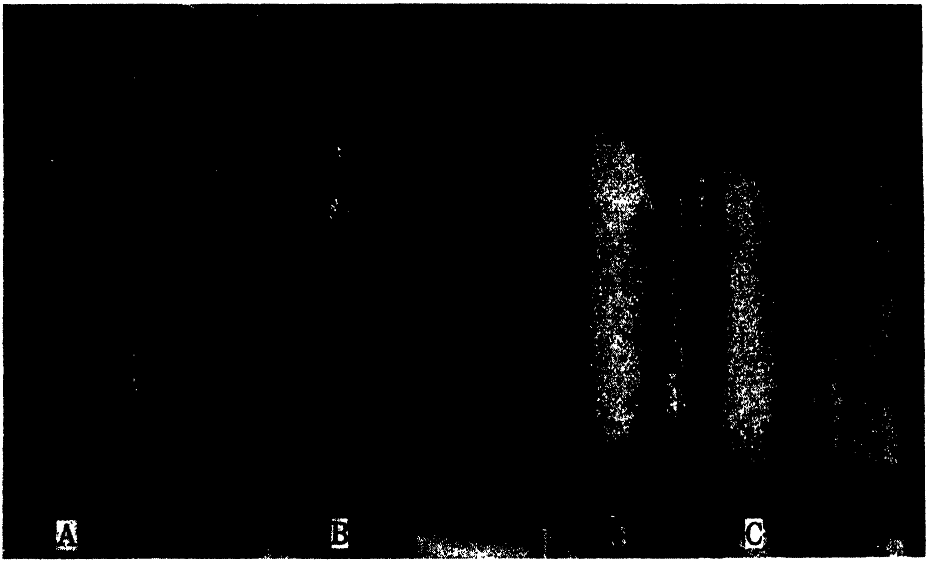


FIG. 2. Black *Aspergilli* on strips of grey cotton duck in test tubes. From same experiment as shown in figure 1 at end of 14-day incubation period. Showing uniformity of growth obtained for replicates and contrast between PQMD *102d*, representing the *A. luchuensis* series and TC *215–4247* representing *A. niger sensu stricto*. A. control; B, PQMD, *102d*, fruiting so heavily as to almost obscure the fabric; C, TC *215–4247*, showing little evidence of growth except for the presence of a few heads at the extreme tops of the strips. × approx. ⅔.

globosum. The growth (fig. 1) of the various *luchuensis* strains, consisting visually of fruiting structures with little evidence of vegetative mycelium, varied somewhat in pattern among the various strains, but was in general heavy, evenly distributed, and reached approximately its maximum development in seven days or a little more. In strains other than of the *A. luchuensis* series growth was extremely meagre, being evidenced only by a few scattered fruit bodies mostly at the upper end of the cloth strip. In general the amount of visual growth was roughly correlated with the effect of the various strains on the tensile strength of the fabric. No pigmentation was produced by any of the strains. The point of greatest cellulolytic activ-

ity on the strips of fabric, as indicated by the points of breakage of the strips on the Scott tester, was very slightly above the water line for *Chaetomium globosum* and the stronger strains of the *luchuensis* series, i.e., *102d* to JQMD *745;* for the weaker strains the breaks occurred somewhat at random above the water line; and for the controls and the remaining non-active strains of the *niger* group they were completely at random.

Experiment 2. Activity of Strains of Miscellaneous Species of Black Aspergilli from Northern Regional Research Laboratory on Grey Cotton Duck (figs. 4–5). Up to this point, including this paper and the preceding one (White, Darby, et al.), a total of 39 strains of the black group were tested. Eight were identified as members of the *A. luchuensis* series. All proved to be cellulolytic. Thirty-one were determined to be non-members of the *luchuensis* series. All of these were non-cellulolytic. Of the 31 it may be assumed that the majority were *A. niger* sensu stricto. It is possible that other species of the black group were represented.

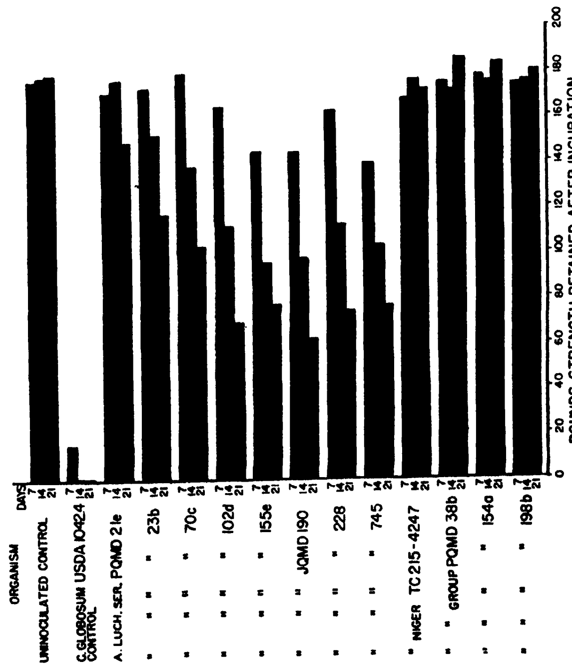
However, in order to be sure that the assays covered a wide range of forms, isolates of several additional known species were obtained from Dr. Raper for further tests.

The entire procedure in this experiment was the same as for the preceding one, except that the previously employed 7-, 14-, and 21-day incubation priods are changed to 14, 21 and 28 days. The USDA strain of *Chaetomium globosum* was again included for comparison and PQMD *102d* was repeated for the same reason. The results are presented in figures 4 and 5.

The results presented in figures 4 and 5 indicate cellulolytic activity for only three of the NRRL cultures, viz: *A. japonicus,* NRRL *358* and NRRL *359* and, for *A. niger* mut. *Schiemanni,* NRRL *361.* NRRL *359* was substantially equivalent to the strongest of the PQMD strains of the *A. luchuensis* series in the decline caused in tensile strength and in amount of growth produced, while *358* was weak in both respects. All members of the remaining 8 taxonomic categories failed to affect the strength of the fabric or to make appreciable growth, and it is noteworthy that this was true of the numbers determined as *A. luchuensis* and *A. violaceo-fuscus.*

The mutant *Schiemanni* produced an amount of growth and a decline in tensile strength of the fabric equivalent to the stronger strains of the *A. luchuensis* series. This is out of line and poses an interesting question as to the origin of the so-termed "mutant." It is a pale ochraceous form having little superficial resemblance to the general run of the *A. niger* group. If it mutated from a member of the *A. niger* series it must have, in addition to the loss of spore color and markings, acquired the property of being able to split cellulose; if it arose from members of the *A. luchuensis* series it acquired primary sterigmata.

Also worthy of comment is the fact that the NRRL cultures of *A. japoni-*



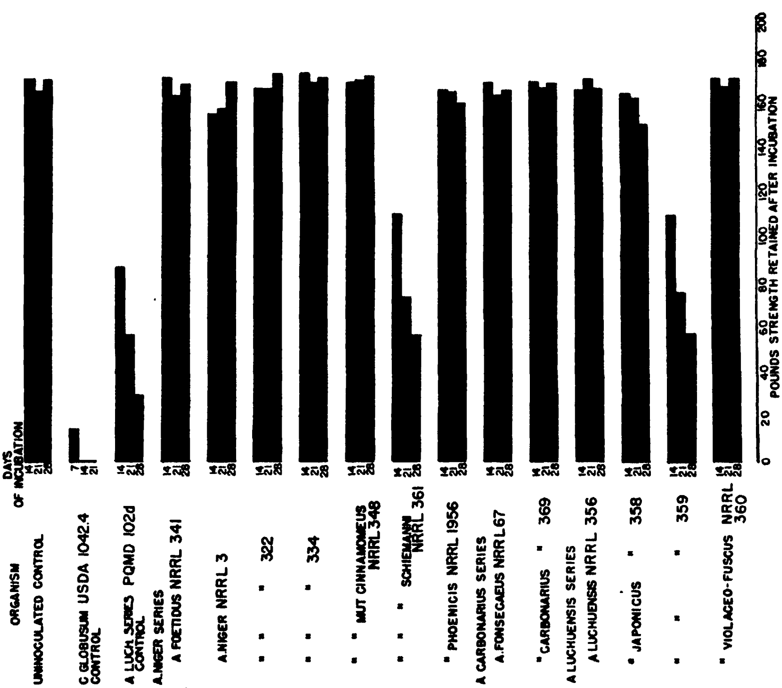


Fig. 3 (left). Cellulolytic activity of members of the *Aspergillus luchuensis* series on grey cotton duck. Fig. 5 (right) Cellulolytic activity of NRRL cultures, representing miscellaneous species of the *A. niger* group, on grey cotton duck.

cus after having been in pure culture for a great many years, presumably on Czapek's medium with sucrose as the carbon source, conformed upon their first transfer to a cellulosic substratum with the pattern of behavior of our own more recent isolates. Mutant *Schiemanni* had been in pure culture on similar sugar media since 1912. What its original cellulolytic strength might have been, is of course not known. Such instances do, however, tend to counter the feeling on the part of some workers that maintenance of stock cultures on sugar media will cause them to loose their cellulolytic properties.

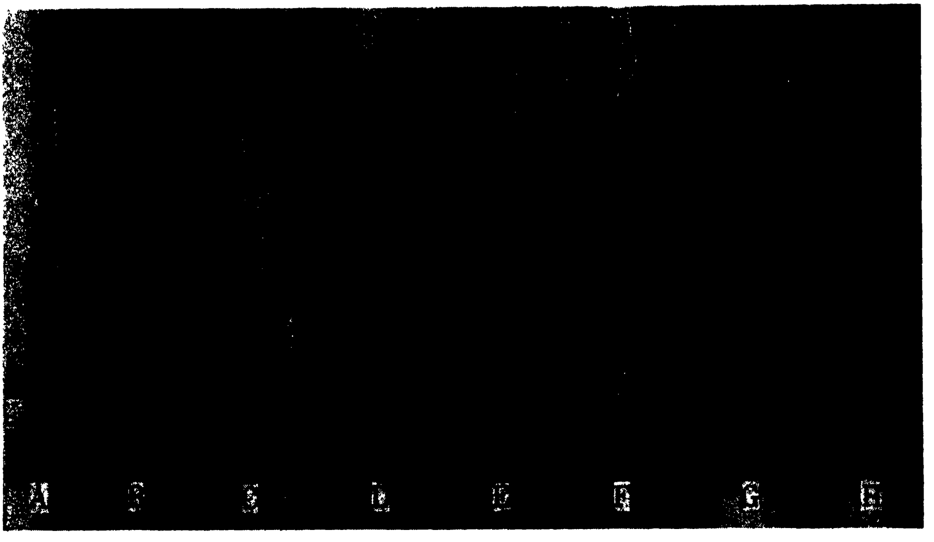


FIG. 4. Strips of grey cotton duck in test tubes after having been inoculated with strains of miscellaneous species of the *A. niger* group and incubated for 28 days at 85° C. A, uninoculated control; B, *A. niger* mut. *Schiemanni*, NRRL, *361*; C, *A. Phoenicis*, NRRL *1956*; D, *A. Fonsecaeus*, NRRL *67*; E, *A. carbonarius*, NRRL *369*; F, *A. luchuensis*, NRRL *356*; G, *A. japonicus*, NRRL *358*; H, *A. japonicus*, NRRL *359*, × 3/5.

Experiment 3. Effect of Yeast Extract on Cellulolytic Action of Aspergillus luchuensis Series, JQMD *745*, on Bleached Cotton Duck. (table 1). Since, under the conditions of the cellulolytic tests (White, Darby et al.) to which brief reference was made on previous pages, the strains which were of other than the *A. luchuensis* series were inactive on both grey duck and bleached sheeting, and since the two *luchuensis* strains (PQMD *23b*, and JQMD *745*) were active on grey duck but not on bleached sheeting, the question arose as to whether the differential ability of these forms to attack grey duck and not bleached sheeting was due to a chemical alteration of the latter fabric by the sodium hydroxide and sodium hypochlorite bleach or to a removal of necessary growth factors.

The following experiment was conducted to investigate this point. Strips of hypochlorite-bleached and unbleached cotton duck ravelled to 3×1 inches, were placed 1 each in 15×150 mm. Pyrex test tubes. Each tube contained 8 ml. of the medium indicated below,[5] which was considerably modified from Fries' medium no. 3 (Fries 1938), with or without the addition of 0.1 per cent Difco yeast extract. The procedure from there on was similar to that of experiments 1 and 2. The decline in tensile strength was taken as an index of mycological action, as presented in table 1.

TABLE 1. *Effect of yeast extract on activity of JQMD 745 of the A. luchuensis series on cotton duck.*

Cloth	Yeast extract in medium	No. of replications	Tensile strength in lbs.			% loss in tensile strength	
			0 days	9 days	15 days	9 days	15 days
Grey duck	Absent	16	156	101	79	35	49
	Present	16	158	96	71	39	55
Bleached duck	Absent	16	122	106	102	13	16
	Present	16	124	82	66	34	47

The data in table 1 clearly show a stimulating action of yeast extract on the cellulolytic activity of JQMD *745*. When grey duck was used the increase in cellulolytic activity was slight. However, while the organism was able to degrade bleached duck only slightly in the absence of yeast extract, the addition of yeast extract increased the rate of degradation to that of grey duck. This indicates that the failure of JQMD *745* to degrade bleached cotton fabric is not due to a chemical modification of the cellulosic substrate into a resistant derivative, but to the removal of necessary supplementary "nutrilites" found in grey duck.

Pertinent to the above, it may be pointed out that many workers have established that certain or perhaps most strains of the *A. niger* group do not require vitamins and similar organic growth factors for normal development. This apparently is true of TC *215–4247*.

Experiment 4. Growth on Filter Paper of the Strains used in Experiment 1 (fig. 6). Discs of Whatman's No. 2 filter paper 7 cm. in diameter (previously sterilized in a hot-air oven at 170° C for 2 hours) were placed 1 each in standard 9 cm. petri dishes each containing 35 cc. of Greathouse formula A mineral salts (as used in exp. 2 & 3) in 2% Bacto agar and inoculated with the same series of organisms as that used in experiment 1.

[5] Composition per liter: NH_4NO_3, 3.0 gm.; KH_2PO_4, 1.0 gm.; $MgSO_4 \cdot 7H_2O$, 0.5 gm.; NaCl, 0.1 gm.; $CaCl_2$, 0.1 gm.; $CuSO_4 \cdot H_2O$, 0.25 mgm.; $Fe_2(SO_4)_3 \cdot H_2O$, 0.544 mgm.; $MnSO_4$, 0.055 mgm.; $ZnSO_4 \cdot 7H_2O$, 4.97 mgm.; $(NH_4)_3[P(MO_3O_{10})_4]$, 0.02 mgm.; H_3BO_3, 0.057 mgm.

For inoculum each organism was grown for about 24 hours on potato dextrose agar (5 gm. dextrose per l.) and a bit of the agar 1–2 mm. square containing the non-sporulating mycelium was transferred to the center of each filter paper disc. The dishes were then spread out on a laboratory table under room conditions and allowed to incubate for 15 days.

While the *Chaetomium globosum*, carried along for comparison, grew rapidly (fig. 6A), no growth over and above that to be expected as a result of nourishment in the inoculum was made by any of the strains of the black

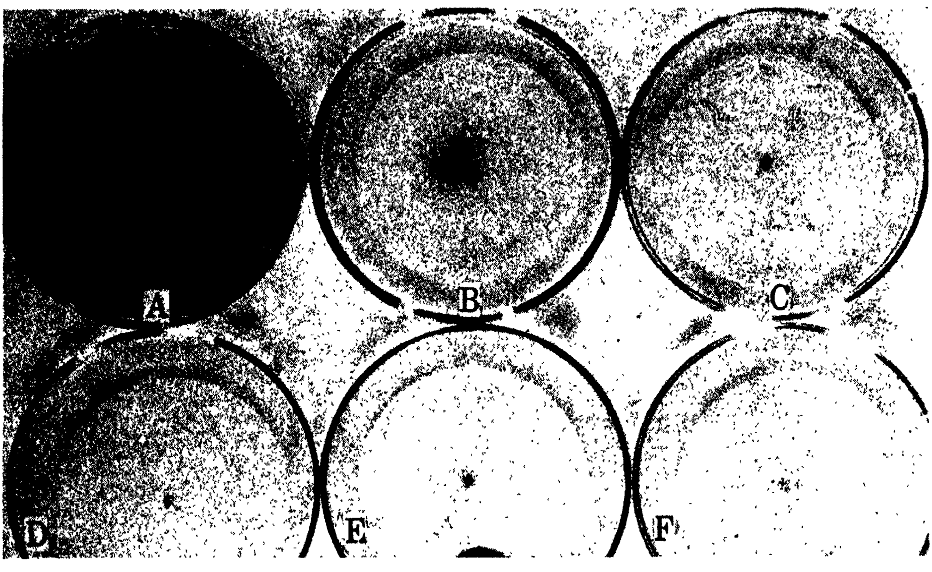


FIG. 6. Growth of black *Aspergilli* on filter paper discs on mineral salts agar following inoculation at a central point, followed by 15 days incubation under room conditions; A, *Chaetomium globosum*, USDA *1042.4* for comparison; B, C, D, *Aspergillus luchuensis* series PQMD *102d*, JQMD *228*, and JQMD *745* respectively; E, *A. niger*, TC *215-4247*; F, an unidentified member of the *A. niger* group (not in *A. luchuensis* series), PQMD *38b*. × slightly more than ½.

Aspergilli (fig. 6 B-F). In all cases it was characterized by sparse, incipient and aborted fruit bodies scattered within an area of a few mm. from the point of inoculation. Individual differences were small and scarcely worthy of record. The best development was reached by PQMD *102d* which formed small conidiophores over an area of a 15 mm. radius from the center (fig. 6B). In no case was there any pigmentation, superficially visible mycelium or other evidence of activity. The relative growth of the *Chaetomium* plus 5 strains of the *Aspergilli* tested (listed in exp. 1), including strains of the *A. luchuensis* series as well as of other species, were incapable of utilizing filter paper as a carbon source.

Experiment 5. Activity on Filter Paper and Bleached Cotton Sheeting on Mineral Salts Agar with and without Yeast Extract (fig. 7, table 2). On the assumption that in experiment 4 the failure of the various

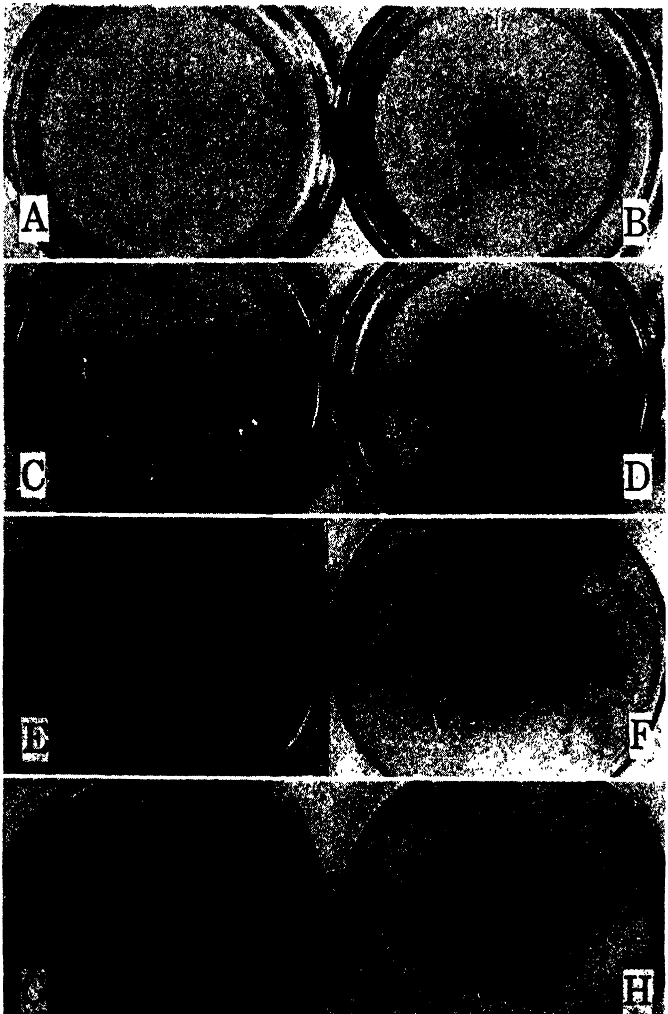


FIG. 7. Growth of two species of black *Aspergilli* on filter paper and bleached cotton sheeting on mineral salts agar, with and without yeast extract, following inoculation at a central point with a small bit of agar with non-sporulating mycelium, followed by 15 days incubation under room conditions; A–E, *A. luchuensis* series, PQMD *102d;* A, no yeast extract; B, 0.01 yeast extract; C, 0.001 yeast extract; D, 0.01 yeast extract; E, 0.1 yeast extract; F–H, *A. niger sensu strictu,* TC *215–4247,* with 0.1 yeast extract; F, without cellulose; G, on bleached sheeting; H, on filter paper. × ½.

strains of the *A. luchuensis* series to break down filter paper was due to a nutritional deficiency, rather than to any peculiarity of the cellulose, a similar set of tests was made, in which yeast extract was added to the medium. As representative of the *A. luchuensis* series, the numbers PQMD *102d* and JQMD *190* were chosen because of their previously demonstrated relatively strong action on grey duck, and for strains outside the *A. luchuensis* series, TC *215–4247* and PQMD *38b* were chosen for comparison or contrast because of their complete lack of action on duck.

The cellulosic materials employed were filter paper from the same lot as that of experiment 4, and also 3.3 oz. bleached cotton sheeting cut to 3 × 1 inch strips. The filter paper, as previously, was subjected to hot-air sterilization, while the cloth was subjected to standard steam sterilization of 20 minutes at 15 lbs. pressure. The same agar medium was used except that percentages of yeast extract were added as indicated in table 2. Inoculation and incubation was as in experiment 4.

TABLE 2. *Growth on filter paper and bleached cotton sheeting on mineral salts agar with and without yeast extract after 15 days incubation.*

Organism	Yeast extract	Control	Filter paper	Cotton sheeting
A. luchuensis series, PQMD 102d	0.0	+	++	++
	0.0001	++	+++	−++
	0 001	+++	++++	+++
	0.01	+++	+++++	+++
	0.1	++++	++++++	++++
A. luchuensis series, JQMD *190*	0.0	0	+	+
	0.0001	+	++	+
	0.001	++	++	++
	0.01	++	+++	++
	0.1	+++	++++	+++
A. niger, TC *215–4247*	0.0	+	+++	++
	0 0001	++	+++	++
	0.001	+++	+++	+++
	0.01	+++	++++	++++
	0.1	++++	+++++	+++++
A. niger group, PQMD *38b*	0.0	+	+++	+++
	0 0001	++	+++	+++
	0.001	+++	+++	+++
	0.01	+++	++++	++++
	0.1	++++	+++++	+++++

Estimates of visual growth are indicated by + signs in table 2. These signs are used to indicate relative growth in this experiment alone and have no relation to usage elsewhere. The values of the signs may be had by comparison with the corresponding categories in figure 7.

The following points may be made from the table: (1) In marked contrast to the results of experiment 1 where grey duck was used as cellulose,

the two strains of the *A. luchuensis* series (PQMD *102d* & JQMD *190*) received no more stimulation from filter paper than did those (TC *215–4247* & PQMD *38b*) which were entirely inactive on the duck; (2) growth on the filter paper and bleached sheeting was slightly greater than on the corresponding mineral salts-yeast extract controls, but no more so than might be expected to result from added impurities or mere mechanical stimulation; (3) growth of both categories of organisms was essentially proportional to the amount of yeast extract used; (4) the slight differences in the amounts of growth produced by the 4 strains are due to their ability to utilize the ingredients of the yeast extract rather than to their ability to act on the cellulose; (5) the essential factors brought out in this experiment and those on preceding pages is that certain strains of the *A. luchuensis* series have been shown to be capable of breaking down the cellulose of grey duck but not of commercial filter paper or commercial bleached sheeting.

Experiment 6. Action of Strain JQMD *190* of the A. luchuensis Series on Ground Filter Paper and Ground Bleached Cotton Cloth in Shaker Flasks with and without Yeast Extract (table 3). In view of the general failure of the organisms to act on bleached cotton cloth and on filter paper by the methods described in the preceding tests, the following experiment was undertaken to determine the behavior on these substrata, with and without yeast extract, employing the shaker technique previously described by Reese (1947).

Culture JQMD *190* was used because it was one of the most active, as measured by tensile strength tests, of the various strains tested on grey duck. As cellulose, 0.5 by weight of bleached cotton sheeting or filter paper was added, with and without yeast extract, to the mineral salts solution outlined below.[6]

Flasks of 250 ml. capacity, to each of which was added 25 ml. of the nutrient solution plus substrate, were subjected to standard autoclaving,

[6] In grams per l.: KH_2PO_4, 1.4; $MgSO_4 \cdot 7H_2O$, 0.75; NH_4NO_3, 1.0; $CaCO_3$, 0.005; NaCl, 0.005; $FeSO_4 \cdot 7H_2O$, 0.001; $MnSO_4$, 0.0001; water (deionized) to 1000 ml.

PQMD	*21e*	Tarpaulin	Russell Islands	11 Sept. 1944
"	*23b*	Manila rope	Espiritu Santos	6 Sept. 1944
"	*70c*	Australian shoe	Finschafen, N. Guin.	14 Oct. 1944
"	*102d*	Helmet lining, leather	" "	29 Nov. 1944
"	*124g*	Grey cotton duck	Panama Canal Zone	23 Dec. 1944
"	*155e*	Tentage	Munda, New Georgia	28 Mar. 1945
"	*321*	Salvage material	Phila. Naval Yard	1941
JQMD	*190*	Japanese tent	New Guinea	18 Sept. 1944
"	*228*	" tarpaulin	Hollandia, N. Guin.	10 Nov. 1944
"	*701*	Sidewall of tent	Port Moresby, N. Guin.	1 Mar. 1945
"	*745*	Tentage	" " "	9 Mar. 1945
"	*851*	Top of tent	Oro Bay, New Guin.	12 Apr. 1945

and after cooling were inoculated with 1 ml. of a spore suspension prepared by washing spores off a mat formed on a sucrose-mineral salts solution. The flasks were incubated on a shaker at a temperature of 23–26° C for three weeks. At the end of the incubation period the flasks were removed, 1 ml. of a 5.0 N NaOH solution was added to each, followed by autoclaving for 15 minutes, to destroy as much of the fungus substance as possible. The contents were then filtered on a gooch, dried, weighed, ashed, and reweighed. The difference in weights is a measure of the ash-free residue. The results are indicated in table 3.

The results presented in the table indicate that the organism probably exerted no action against either bleached cotton sheeting or filter paper. Addition of yeast extract or of sucrose resulted in losses of 2–3 per cent in three weeks. These data, however, are not adequate to establish statistical significance, but the loss, though small, is consistent. If it is to be regarded as significant, one has to assume an extremely small weight loss in proportion to decline in tensile strength if the results are to be regarded as other than in direct opposition to those presented in experiment 3.

TABLE 3. *Action of strain JQMD 190 of the A. luchuensis series on ground bleached sheeting and ground filter paper in shaker-flasks.*

Substrate	Residue							Loss in wt., %
	Of individual flasks, in mg.						Average	
Cotton, uninoc. controls	142	133	140	144	136	145	140	..
Cotton, without yeast extract	138	143	146	141	137	.....	141	0
Cotton, 0.03 yeast extract	138	143	143	131	135	132	137	2
Filter paper, uninoc. controls	119	123	120	120	117	123	120	......
Filter paper, without yeast extract	125	119	123	124	128	99	120	0
Filter paper, 0.03 yeast extract	116	108	119	119	114	119	116	3
Filter paper, 0.03 sucrose	109	110	126	113	129	113	117	2.5

Experiment 7. Action of Strains of the Aspergillus luchuensis Series on Bleached Cotton Sheeting in Close Proximity with Grey Cotton Duck (fig. 8, table 4). On the basis of the results thus far obtained it appeared probable that despite the lack of any attempts toward a high degree purification of either cellulosic substrate or culture medium the apparent differential in behavior of strains of the *A. luchuensis* series on grey cotton duck on the one hand and on the more highly purified bleached sheeting or filter paper on the other, was of a nutritional nature—that grey duck supplied certain nutritive factors necessary to cellulolytic activity which were not present in sufficient quantity in the sheeting and filter paper.

To determine this the following set of tests, a repetition of experiment 1 in all essential factors was conducted in which a strip of bleached sheeting

was superimposed on each strip of duck. The bleached strip was placed uppermost so that it fitted into the concavity of the duck, the two strips thus adhering closely together without any fastening being necessary. The inoculations, which have always been made by drawing the tip of the pipette upward from the solution to the top of the strip, were made in the same manner in this experiment, which means, of course, that the spore load was deposited on the sheeting.

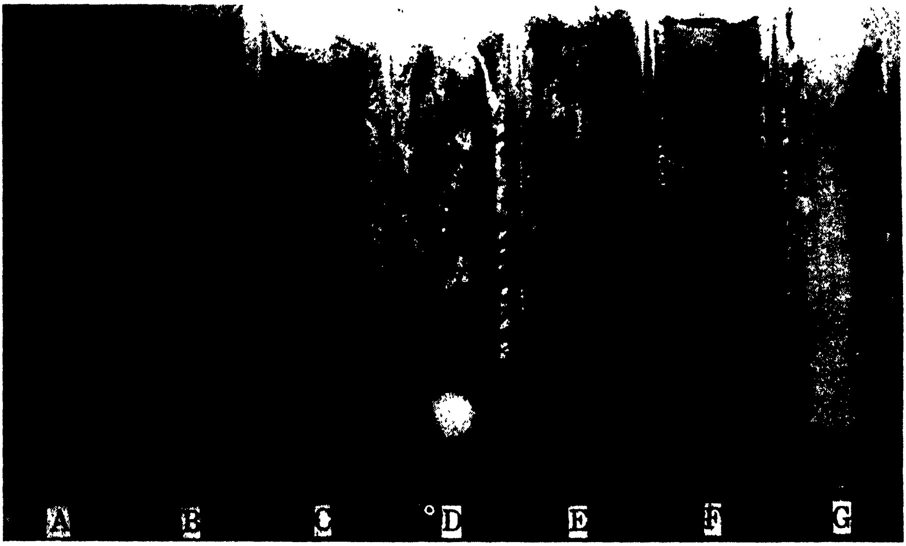


FIG. 8. Strains of the *Aspergillus luchuensis* series on strips of bleached cotton sheeting superimposed on strips of grey duck after an incubation period of 28 days. A, uninoculated control; B, *Chaetomium globosum* USDA *1042.4* for comparison; C–F, *Aspergillus luchuensis* series: C, PQMD *23b;* D, PQMD *102d;* E, PQMD *155e;* F, JQMD *190;* G, *A. niger*, TC *215–4247* for comparison. × 1.

The several strains of the *A. luchuensis* series which were used were selected from the previous tests, and as in previous tests *Chaetomium globosum*, USDA *1042.4*, and *Aspergillus niger*, TC *215–4247*, were carried along for comparison.

The grey duck used was of 12 oz. weight, from the same lot as that of experiment 1, breaking at 170 lbs. on the Scott tester, while the sheeting was 3.3 oz. weight breaking at about 37 lbs.

The strains employed, the incubation intervals, and results in terms of percent tensile strength retained at harvest are indicated in table 4. The percentages are based on controls of each type of cloth incubated but not inoculated and recorded as 100. Five replicates were employed in each case.

At the 14- and 28-day (figure 8) harvests the growth patterns did not

differ markedly from each other or from those described for previous tests. The strips inoculated with *Ch. globosum* were well covered with perithecia, the greatest concentration being just above the water line, which also was the point of greatest cellulolytic action. Those inoculated with strains of the *luchuensis* series showed a heavy and for the most part evenly distributed growth on all above-water portions of the strips except where they were in direct contact with the glass. Breakage points were at random on the above-liquid portions of the strips. In the case of *A. niger* the only visual growth was a pellicle on the surface of the liquid and very sparse and aborted fruit bodies mostly at the extreme upper ends of the strips, with breakage completely at random.

TABLE 4. *Cellulolytic action of strains of the Aspergillus luchuensis series on bleached cotton sheeting in close proximity with grey duck.*

Organism	Per cent strength retained after incubation				Final pH of sol'n
	14 days		28 days		
	Grey duck	Bleached sheeting	Grey duck	Bleached sheeting	
Uninoc. control	100	100	100	100	7.1
Chaetomium globosum, USDA *1042.4*	2.0	0	0	0	6.7
A. luchuensis series, PQMD *23b*	68	61	40	35	6.7
A. luchuensis series, PQMD *102d*	56	49	32	30	4.0
A. luchuensis series, PQMD *155e*	55	48	40	36	7.0
A. luchuensis series, JQMD *190*	60	58	37	40	6.4
Aspergillus niger, TC *215–4247*	103	103	104	103	7.6

The pH readings given in the table are averages for 5 replicates but in no case, except for PQMD *102d* which varied from 3.8 to 4.2, was the variation among replicates greater than a few hundredths of a unit.

Experiment 8. Summarizing Assay of Strains of the Aspergillus luchuensis Series on Grey Duck (figs. 9–10, table 5). There were at hand strains of the *A. luchuensis* series which had not yet been tested for cellulolytic action, namely PQMD *321,* JQMD *701,* and JQMD *851.* Strain PQMD *124g* had been tested only on bleached sheeting (White, Darby et al.) and had given negative results. Two strains, PQMD *21e* and NRRL *358,* when tested on grey duck, had exhibited, at best, very weak action, although in showing a certain amount of activity and growth they behaved true to type as strains of the *A. luchuensis* series in contrast to strains of other species of the *A. niger* group. Seven strains, PQMD *23b, 70c, 102d, 155e,* JQMD *190, 228,* and *745* had exhibited somewhat stronger action and more growth than PQMD *21e* and NRRL *358.*

The following test was conducted to check the foregoing results by testing all cultures concurrently.

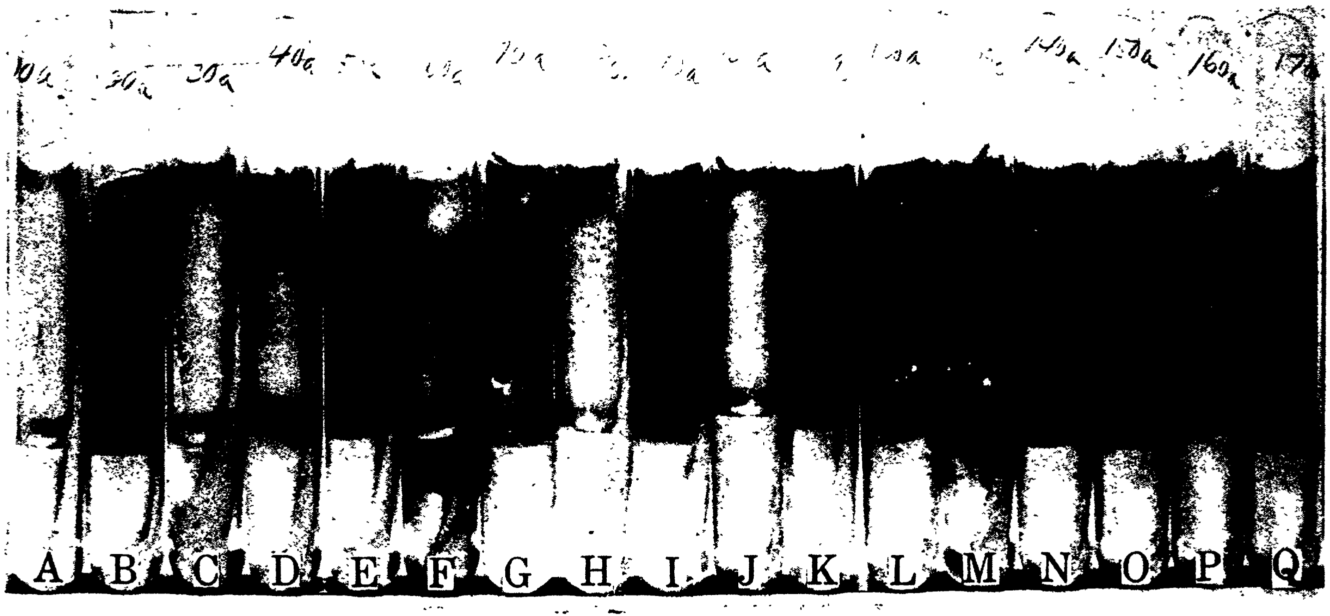


FIG. 9. Comparative growth patterns and amounts of growth produced by various strains of the *A. luchuensis* series on strips of grey cotton duck after a 6-weeks incubation period. A, uninoculated control; B, *Chaetomium globosum*, USDA *1042.4*, for comparison; C, *A. niger*, TC *215–4247*, for comparison; D–O, Unnamed members of the *A. luchuensis* series: D, PQMD, *21e*; E, PQMD *23b*; F, PQMD *70c*; G, PQMD *102d*; H, PQMD *124g*; I, PQMD *155e*; J, PQMD *321*; K, JQMD *190*; L, JQMD *228*; M, JQMD *701*; N, JQMD *745*; O, JQMD*851*; P–Q, *A. japonicus*: P, NRRL *358*; Q, NRRL *359*. × ⅓.

The methods and procedures were as in experiment 1 except that the test tubes used were of soft glass instead of Pyrex and the incubation periods were lengthened.

The results are presented in figures 9 and 10 and table 5.

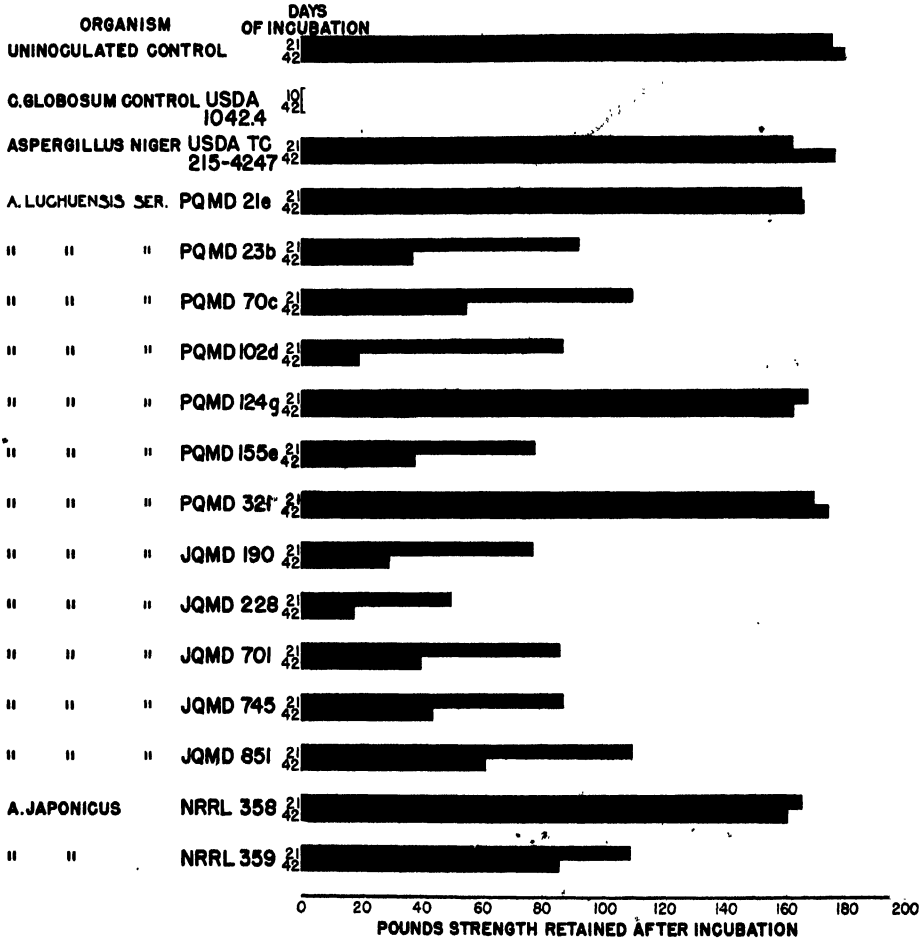


FIG. 10. Summarizing assay of cellulolytic activity of strains of the *A. luchuensis* series on grey cotton duck.

FIELD OCCURRENCE

The cultures of the *A. niger* group that are dealt with in this paper, with the exception of PQMD *321* (see table below), TC *215–4247*, and those furnished by Dr. Raper (NRRL), were isolated from military materials that had undergone deterioration in the tropics. The samples of mate-

rials were received as a result of requests sent out to the various theatres by Prof. W. H. Weston who was at that time Consultant to the Office of the Quartermaster General on mold problems. Each sample was wrapped to preclude air contamination in transit and was accompanied by certain pertinent information which had been requested. But although the utmost precautionary measures were taken to prevent contamination of the sample between the points of field preparation for shipment and the opening of the package in our own transfer room there still remains the fact that the appearance of a species in the petri dish in isolation attempts in the laboratory does not in itself constitute any criterion of the activity of that species on the particular sample.

TABLE 5. *Final pH readings of solutions.*[a]

Organism	pH of solution	
	After 3 week incub. period	After 6 week incub. period
Uninoc. control	7.2	7.1
Chaetomium globosum, USDA *1042.4*	7.0	6.5
A. niger, TC *215–4247*	7.6	7.4
A. luchuensis series, PQMD *21e*	7.3	7.2
A. luchuensis series, PQMD *23b*	6.7	6.3
A. luchuensis series, PQMD *70c*	6.8	6.0
A. luchuensis series, PQMD *102d*	4.0	3.9
A. luchuensis series, PQMD *124g*	7.2	7.0
A. luchuensis series, PQMD *155c*	7.0	6.9
A. luchuensis series, PQMD *321*	7.5	7.3
A. luchuensis series, JQMD *190*	6.5	5.8
A. luchuensis series, JQMD *228*	6.3	4.3
A. luchuensis series, JQMD *701*	6.7	6.4
A. luchuensis series, JQMD *745*	6.7	6.3
A. luchuensis series, JQMD *851*	6.7	6.2
A. japonicus, NRRL *358*	7.3	7.0
A. japonicus, NRRL *359*	6.9	6.7

[a] Original solution after autoclaving 7.2.

The name of the item, the region from which it came, and date and place of isolation for each of the cultures identified as belonging in the *A. luchuensis* series is shown below. The isolates with the exception of PQMD *321*, were made either at the Philadelphia or the Jeffersonville (Indiana) Quartermaster Depots, as indicated by the prefix to the assession number. They have been maintained on potato dextrose agar slants.

The samples from which the PQMD series of isolates were made were preserved and were carefully re-examined before this writing. Although most of them have one or more species of fungi fruiting on the surface, there are none which upon careful microscopic examination exhibit any structures reminiscent of those of members of the *A. niger* group. This is

illustrative of the experience of the writers in making examinations and isolations from hundreds of samples of molded fabrics, paper, and like materials. In our laboratory, isolations from fabrics have usually been made by removal of fibers or threads from the sample and planting them on several kinds of agar media including potato dextrose, acidified potato dextrose, nutrient, cellulose dextrin, and often also filter paper strips partially immersed in a mineral salts solution. In these procedures, black *Aspergilli* appear very frequently, especially on the sugar media. Actual proof that

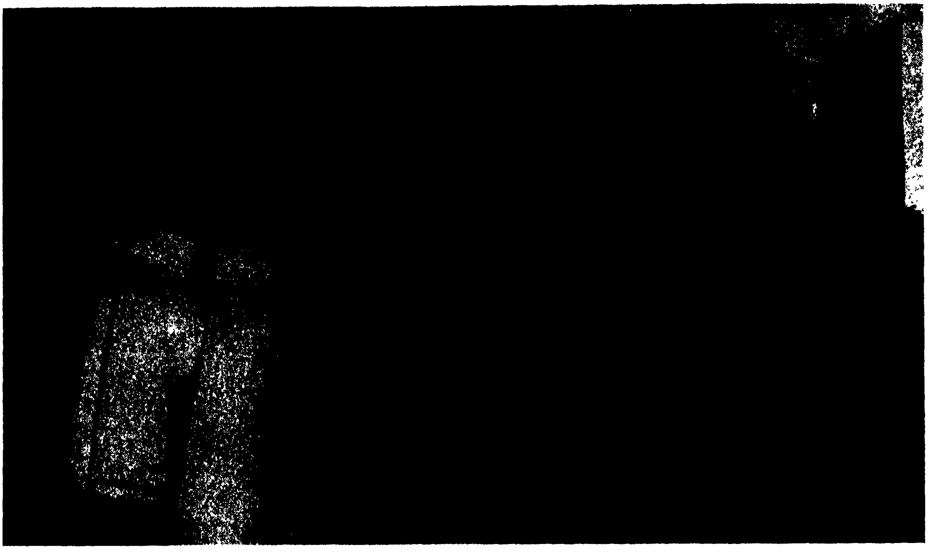


FIG. 11. Woolen trousers of Australian manufacture showing heavy infestation of the heavily sized cotton lining materials by a member of the *A. niger* group. This is one of several pairs in similar condition, unused, taken by the senior author from a wooden carton in a U. S. Army Quartermaster warehouse on Biak Island. Excessive dampness was caused by periodic flooding of the coral floor to a depth of about 6 inches with the water at times touching the bottom of the carton. × ¾.

they are present on the samples other than merely as spores deposited with the dust of the atmosphere is still to be forthcoming. The evaluation of the relation of any one species of fungus to field damage is a very difficult problem to get at. It is still possible, even though the black *Aspergilli* are not among the species that fruit readily on such materials, that through continuous spore deposit, followed by germination and restricted vegetative growth from the energy of the spore and the small amount of nutrient furnished by incidental dirt, there may be considerable deleterious action, especially against fungicides and finishing materials, which may in the aggregate be great.

On the rare occasions when black *Aspergilli* actually have been found in an identifiable state on cotton fabrics, it has been apparent that it was sizing rather than the fabric itself that was furnishing the necessary nutrients. It may be pointed out here that during the period of the 1920's when "*Aspergillus niger*" was mentioned so frequently by those concerned with mold problems in the British cotton textile industry, that the emphasis was on attack of the sizing rather than the base fabric. Flimsy, lightweight fabrics are as a rule more heavily sized than heavy-weight military fabrics, and in so far as can be stated at present it is on the former that the black *Aspergilli* are most apt to be troublesome. In figure 11 is illustrated a severe case of growth in the heavily sized white cotton lining materials of a pair of wool trousers of Australian manufacture. This pair, along with several others in a similar condition, was encountered by the senior author (White 1946) in a U. S. Army Quartermaster warehouse on Biak Island. They had never been issued. The wooden carton in which they were packed was resting on a crudely devised platform about six inches off the coral floor of the open-side shed. Periodic flooding of the floor to a depth of about six inches so that the water touched the bottom of the carton had caused an excess of moisture to be drawn up through the clothing. No growth was found on the wool portions of the garments and the strength of the heavily molded cotton parts did not appear to have been greatly, if at all, reduced. The organism was not a member of the *A. luchuensis* series.

It may be pointed out, incidentally, that members of the *A. niger* group (not identified more specifically) sporulate in profusion on leather products. On shoes stored in humid tropical atmospheres they are often found in solid black mats on the soles, and especially on leather insoles.

SUMMARY

1. In a previous paper (White, Darby et al. 1948) plus the present one, a total of 52 isolates of black *Aspergilli* were tested for ability to decompose cellulose. Of this number, 37 were taken from deteriorated military cotton fabrics and similar materials during the war, 14 were obtained from Dr. Raper of the Northern Regional Laboratory and were of long pure-culture history, and one was the well known and so-called official strain for the assessment testing of mildew-proofness, i.e., TC *215–4247*. They represented a wide range of forms distributed among at least 10 of the 15 taxonomic entities currently recognized in the *Aspergillus niger* group.

2. None of the truly black *Aspergilli* were found to be capable of cellulolytic action. Such activity was confined to the ochraceous *A. niger* mutant *Schiemannii* and to the more or less purple-brown forms which comprise the *A. luchuensis* series. The results seem to warrant the general conclusion that within the *Aspergillus niger* group cellulolytic ability is absent in

the *A. niger* series and *A. carbonarius* series but is, in contrast, a fairly constant feature of the *A. luchuensis* series.

3. Activity was, however, not demonstrated for all the 16 isolates falling within the *A. luchuensis* series. Of 12 strains isolated from military materials, none of which were identified to species, nine gave positive results of about an equal order of magnitude, one (PQMD *21e*) was weak or doubtful, and two (PQMD *124g* and *321*) gave negative results. Of the 4 specifically identified isolates obtained from Raper, *A. luchuensis* and *A. violaceo-fuscus* showed no activity, while for *A. japonicus* strong activity was demonstrated for one culture and weak or doubtful activity for the other. Further study of cellulolytic activity in relation to the current species concepts within the *A. luchuensis* series is highly desirable.

4. The foregoing conclusions are based on decline in tensile strength of strips of cotton fabric. When loss in weight of ground cellulose in liquid cultures or visual growth on filter paper were taken as measures of cellulolytic activity the results were negative, the data being inadequate, however, for the drawing of definite conclusions. Members of the *A. luchuensis* series which were inactive on strips of bleached cotton sheeting partially immersed in a mineral salts solution readily attacked the sheeting when strips of less highly purified grey duck were placed adjacent to them in the vessel, the evidence being that the nutrition of these fungi is not of the simplest type.

5. Under field conditions the black *Aspergilli* have been found in an identifiable, i.e., sporulating, condition only on light-weight heavily sized fabrics, usually in storage or transit. They appear frequently in isolation procedures from tentage and other heavy size-free military fabrics but there is no evidence that they exist on the material as other than spores deposited with the dust of the atmosphere. It is possible, however, that under field conditions these fungi may through the process of constant and repeated spore germination and slight vegetative growth resulting from incidental dirt do damage to fungicidal and other finishing treatments which may in the aggregate account for considerable economic loss. They are known to be capable of attacking a wide range of materials and to have generally high fungicidal tolerance.

6. In the laboratory, strains of the *A. luchuensis* series have equaled or excelled those of other members of the *Aspergillus niger* group in growth and activity on cellulosic materials and should be given further consideration for possible use in assessment testing for mold-proofness of such materials. Recommendation for such use is withheld, however, pending further work on their nutrition in relation to decomposition of cellulosic materials and a determination of their relative fungicidal tolerances.

UNITED STATES ARMY QUARTERMASTER CORPS BIOLOGICAL LABORATORIES
PHILADELPHIA, PENNSYLVANIA

Literature Cited

1. *AATCC Sub-Committee on Mildew Proofing.* 1945. Report on A. A. T. C. C. cooperative tests for determining mildew- and rot-resistance, November, 1943–July, 1944. Am. Dyest. Report. 26 Mr 1945.
2. **Appling, J. W. & McCoy, J. F.** 1945. Relative toxicity of disinfectants recommended for use in the paper industry. II. Inhibiting concentrations for Bacillus mycoides and Aspergillus niger. Paper Trade Jour. Tech. Sect. **121:** 37–40.
3. **Armstead, Dorothy & Harland, Sydney Cross.** 1923. The occurrence of mildew in black-bordered dhooties. Jour. Text. Inst. **14:** *T475–T481, pl. 1–2.*
4. **Bayley, C. H. & Weatherburn, M. W.** 1945. Observations on the growth of some copper tolerant fungi on cotton fabrics. Am. Dyest. Report. **34:** 247–248.
5. **Bertolet, Elmer C.** 1944. Observations on soil burial procedures. Symposium on Mildew Resistance, Am. Soc. for Testing Materials, 23–36.
6. **Bright, Thomas Binstead, Morris, Leslie Ewart & Summers, Frederick.** 1924. Mildew in cotton goods. Jour. Text. Inst. **15:** *T547–T558, pl. 1–4.*
7. **Bright, Thomas Binstead.** 1926. The microscopical examination of damaged cotton hairs by the congo red test and the swelling test of Fleming and Thaysen. Jour. Test. Inst. **17:** T396–T404.
8. **Brown, A. E.** 1946. The problem of fungal growth. Modern Plastics **23:** 189–195, 254, 256, *7 figs. + tables 1, 2.*
9. **Dorée, Charles.** 1923. Fibers, textiles, cellulose, and paper. *In:* Reports of the progress of applied chemistry. Soc. Chem. Ind. **8:** 129–161.
10. **Fries, Nils.** 1938. Über die Bedeutung von Wuchsstoffen für das Wachstum verschiedener Pilze. Symb. Bot. Upsal. **3: 2:** 1–188, *f. 1–25 + tables 1–71.*
11. **Galloway, L. D.** 1930. The fungi causing mildew in cotton goods. Shirely Inst. Mem. **9:** 27–36, *f. 1–2 + tables 1–2.*
12. ————. 1931. Diamond spot mildewed cotton fabric: Investigation. Jour. Text. Inst. **22:** T494–96.
13. **Gerry, Eloise.** 1923. Jour. Agr. Res. **26:** 219–229, *pl. 1–4 + table 1.*
14. **Greathouse, Glenn A., Klemme, Dorothea E. & Barker, H. D.** 1942. Determining the deterioration of cellulose by fungi. Indust. & Eng. Chem. Indust. Ed. **14:** 614–620, *f. 1–8.*
15. **Iterson, G. van, Jr.** 1903. The decomposition of cellulose by aerobic microorganisms. Akad. Wetensch. Amsterdam, Proc. Sect. Sci. **5:** 685–703, *fig. 1–9.*
16. **Kanagy, Joseph R., Charles, Arbelia M., Abrams, Edward & Tener, Rees F.** 1946. Effects of mildew on vegetable tanned strap leather. Jour. Am. Leath. Chem. Assoc. **41:** 198–213, *f. 1–7 (graphs) + tables 1–5.*
17. **Klemme, Dorothea, Greathouse, Glenn A., Bollenbacher, Katharina & Pope, Seth.** 1945. The deterioration of cotton fabric by certain microorganisms. U. S. Dep. Agr. Circ. **737:** 1–11, *f. 1–5 + table 1.*
18. **Lavers, C. G. & Illman, W. I.** 1946. Packaging. III. Effect of mould growth and ageing on the water-vapour transmission of packaging materials. Canad. Jour. Res. F **24:** 117–122, *f. 1–20 (graphs) + table 1.*
19. **Marsh, Paul B., Greathouse, Glenn A., Bollenbacher, Katharina & Butler, Mary L.** 1944. Copper soaps as rot-proofing agent on fabrics. Indust. & Eng. Chem. **36:** 176–181, *f. 1 + tables 1–9.*
20. **Marsh, Paul B., Greathouse, Glenn A., Butler, Mary L. & Bollenbacher, Katharina.** 1945. Testing fabrics for resistance to mildew and rot. U. S. Dep. Agr. Tech. Bull. **892:** [1]–22, *tables 1–19.*

21. **Norman, A. Geoffrey.** 1930. Biological decomposition of plant materials. Part III. Physiological studies on some cellulose decomposing fungi. Ann. Appl. Biol. **17:** 575–613, *pl. 37–39 + tables 1–18 + graphs 1–24.*

22. **Olson, J. C. & Macy, H.** 1945. Propionic acid, sodium propionate, and calcium propionate as inhibitors of mold growth. I. Observations on the use of propionate-treated parchment in inhibiting mold growth on the surface of butter. Jour. Dairy Sci. **28:** 701–710, *2 figs.*

23. **Paine, Frederick S.** 1927. Studies of the fungous flora of virgin soils. Mycologia **19:** 248–267, *pl. 24–26 + tables 1–3.*

24. **Reese, Elwyn T.** 1947. On the effect of aeration and nutrition on cellulose decomposition by certain bacteria. Jour. Bact. **53:** 389–400, *f. 1–4 + tables 1–7.*

25. **Reiners, A. H.** 1924. Mold and mildew. Conditions favoring development on textile materials—ways to prevent growth. Text. World **65:** 2123, 2127, 2201, 2203.

26. **Ridgway, Robert.** 1912. Color standards and color nomenclature. Washington, D. C.

27. **Scales, Freeman M.** 1915. Some filamentous fungi tested for cellulose destroying power. Bot. Gaz. **60:** 149–153, *table 1.*

28. **Scribner, B. W. & Abrams, E.** 1946. Effect of mildew on caselining materials. Paper Trade Jour. **123:** 132, 134, 136, 138, 140, *tables 1–5.*

29. **Siu, R. G. H.** 1947. Fundamental aspects of the prevention of the microbiological degradation of cotton textiles. Am. Dyest. Report. **36:** P320–P323.

30. **Thaysen, A. C. & Bunker, H. J.** 1927. The microbiology of cellulose, hemicelluloses, pectin and gums. 363 pp. Oxford Press.

31. **Titus, A. C.** 1945. Fungus growths and electric apparatus. Gen. Elect. Rev. **45:** 19–22, *f. 1–8.*

32. **Thom, Charles & Raper, Kenneth B.** 1945. A manual of the *Aspergilli.* 373 pp. Wiliams & Wilkins Co., Baltimore.

33. **White, W. Lawrence.** 1946. Mycological factors. *In:* Report of Army Air Forces Tropical Science Mission, 25–46, *f. 1–16* (Wright Field, Ohio).

34. **White, W. Lawrence, Darby, Richard T., Stechert, Gladys M. & Sanderson, Kathryn.** 1948. Assay of cellulolytic activity of molds isolated from fabrics and related items exposed in the tropics. Mycologia **40:** 34–84, *f. 1–3 + tables 1, 2.*

BULLETIN OF THE TORREY BOTANICAL CLUB

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—VI[109]

BASSETT MAGUIRE AND COLLABORATORS

ARACEAE[110]

The aroids of the Guianas are evidently little known. This may be well illustrated by the following lists of specimens, collected in British Guiana and Surinam by Bassett Maguire, D. B. Fanshawe, and Gerold Stahel. Of a relatively small number of plants, four constitute apparently new species, and for one of these a new genus must be erected. Since three of the novelties were found in the presumably well collected area of Zanderij, we may feel safe in assuming that the araceous flora of the entire region still contains many undetected species.

The relationship of the Araceae of the Guianas is principally with the Amazonian species of northern Brazil, but plants from Venezuela, Colombia, Peru, Trinidad, and Tobago, have also found their way into the area. Endemism among the Guianan aroids is negligible.

ANTHURIUM AMOENUM Kunth. BRITISH GUIANA: epiphyte, Mora Forests, Kamuni Creek, Groete Creek, Essequibo River, frequent, *22823*. A small phase of this widespread and polymorphic species, known in its typical and varietal forms from Venezuela, Colombia, and Peru.

ANTHURIUM GALEOTTII (Hort.) C. Koch. SURINAM: epiphyte in ants' nest, mixed wallaba forest, km. 10, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24860*. Also known from Brazil, mostly in the south-central area.

ANTHURIUM HOOKERI Kunth. SURINAM: terrestrial, high forest, base of south cliffs, frequent, Arrowhead Basin, Tafelberg, *24458*. A splendid large phase of this spectacular and variable big aroid, which is widely distributed in the West Indies and northern South America.

ANTHURIUM KUNTHII Poepp. & Endl. BRITISH GUIANA: spathe green, spadix purple, occasional epiphytic perennial herb usually 4–5 m. up on trees, trail from Tukeit to Kaieteur Plateau, *23061*. This showy species, with large digitate foliage, has previously been recorded from Brazil and Peru.

Anthurium Maguirei A. D. Hawkes, sp. nov. Herba terrestris, parva, variabilis; rhizoma abbreviatum, repens; folia erecta, variabilia; lamina coriacea, elliptica vel obovato-elliptica vel lanceolato-elliptica, ad apicem acuta vel obtusa vel leviter mucronata; nervi prominentes, adscendentes, confluentes; inflorescentia erecta, variabilis; pedunculus cylindricus; spatha erecta vel reflexa, ovato-lanceolata, acuta vel obtusa, leviter undulata, viridis; spadix erectus, cylindricus; flores subquadrati.

109 This is the concluding part of the report on the 1944 Guiana explorations. The preceding five parts have appeared under the above title as follows: Bull. Torrey Club 75: 56–115, 189–230, 286–323, 374–483, 522–579. 1948.

110 By Alex D. Hawkes.

Low terrestial herb, variable in stature and foliage-form. Plants varying from 13.5–33.5 cm. high. Rhizoma rather abbreviated, repent, producing erect leaves and inflorescences at variable intervals, ca. 1.5 cm. in diameter, mostly concealed by the chartaceous, reddish-brown sheaths which gradually deteriorate with age. Leaves stiffly erect, variable, 9.5–33.0 cm. high (including petiole). Petiole 2.5–21.5 cm. high, usually ca. 2 mm. in diameter, rather angular, typically with a deep rather triangular groove running down the front and a somewhat thickened pulvinus at base of blade, broadening slightly basally. Blade 7.5–16.0 cm. long, 2.2–6.5 cm. wide, rather leathery, elliptic to obovate-elliptic or lanceolate-elliptic in shape, with an apex varying from acutish to obtuse or minutely mucronate; veins very prominent on both surfaces, variable in number and size, but with the secondaries always strongly ascending and more or less confluent in a vein which follows the margin of the blade just inside its periphery. Inflorescences rigidly erect, up to 39 cm. high, shorter than or longer than foliage. Peduncle cylindric, to 32 cm. high, ca. 2 mm. in diameter, widening considerably at base. Spathe erect or reflexed, ovate-lanceolate, acute or obtuse, to 3 cm. long and 6 mm. broad, rather undulate, green (fide coll.). Spadix stiffly erect, 2.5–7.0 cm. long (including naken basal portion), cylindrical, ca. 5 mm. in diameter when mature, brownish when dried. Flowers usually with 4 anthers, almost quadrate.

TYPE: leaves coriaceous, spathe and spadix green, frequent bogs border or low bush, Savanna I, Tafelberg, Surinam, August 3, 1944, *Maguire 24218*. New York Botanical Garden.

Anthurium Maguirei is an interesting dwarf species of extremely variable habit, of the section *Xialophyllium* Schott, and is allied to *A. amoenum* Kunth. The excellent series of specimens available under the type number exhibits wide extremes of plant size and foliar shape. It is an attractive small aroid. I take great pleasure in naming it for its discoverer, Bassett Maguire, of the New York Botanical Garden.

ANTHURIUM NIGRESCENS Engl. SURINAM: locally frequent at Cataract 3, Augustus Falls, Tafelberg, *24763*. Previously reported from Colombia. A large species with an olive-green spathe and dark brown spadix.

Anthurium Stahelii A. D. Hawkes, sp. nov. Herba epiphytica; rhizoma elongatum, scandens; petiolus erectus, cylindricus; lamina erecta, rigida, undulata, sagittato-lanceolata, ad apicem acuminata, ad basim lobata; lobi posteriores triangulo-oblongi, obtusi vel truncati; nervi medii prominentes; nervi secondarii ca. 10–12, arcuati, supra obscuri; pedunculus erectus, unicus, cylindricus; spatha magna, erecta vel semi-erecta, ovata vel oblongo-ovata, valde acuta, striata intus, extus glabra; spadix erectus, cylindricus, tenuis, ad apicem attenuatus, obtusus, ad basim nudus; flores quadrangulares vel sexangulares, irregulares.

Epiphytic herb. Rhizome elongate, climbing, ca. 1.5 cm. in diameter, at intervals emitting wiry roots to 1.5 mm. in diameter, with a somewhat roughened and gradually deciduous bark. Petioles erect, apparently cylindric, to 5 cm. high, narrowing slightly toward apex, ca. 1 cm. in diameter, broadening slightly at base. Leaf-blade erect, evidently rather rigidly so, plane, with a slightly undulate margin, 25–35 cm. long, 11.5–18.0 cm. across basal lobes, sagittate-lanceolate, with an apical acumen about 1.5 cm. long, and deep triangular-oblong basal lobes up to ca. 10.5 cm. long and 6

cm. broad which are obtuse or almost truncate at the apex; median vein very prominent, with a strong secondary curving from its base into each basal lobe; secondaries ca. 10–12 on each side, arcuate, sharply down-curved almost at margin, rather obscure on upper side of leaf. Peduncle erect, solitary, 13–24 cm. high, with a basal sheath which is soon deciduous, cylindric, to 4 mm. in diameter. Spathe large and showy, color unknown, apparently erect or semi-erect, ca. 10 cm. long and ca. 5.5 cm. across, ovate or oblong-ovate, with a sharply acute apex, somewhat striate within, rather smooth outside. Spadix erect, cylindric, slender, 8.5–9.5 cm. long, 5.0–5.5 mm. in diameter, narrowing slightly to a rather blunt apex, the basal naked portion ca. 5 mm. long. Flowers quadrangular or sexangular, irregularly shaped, apparently opening slowly and gradually toward the apex.

TYPE: epiphyte, forest, east side, Savanna I, Zanderij, Surinam, October 20, 1944, *Maguire & Stahel 25049*. New York Botanical Garden.

The species is named in honor of Dr. Gerold Stahel, Director of the Agricultural Experiment Station, Paramaribo, Surinam, one of the collectors of the type. It is a member of the section *Calomystrium* Schott, but is apparently not closely allied with any described species of that group.

DIEFFENBACHIA SEGUINA (L) Schott. SURINAM: terrestrial, locally abundant about foot of waterfalls and under drip of the north escarpment, Tafelberg, *24289*. A highly variable aroid with numerous described varieties and sub-varieties which are extensively distributed in the West Indies, Central America, and northern and central South America. It is often cultivated for the beautifully variegated foliage, which when eaten may produce severe paralysis of the vocal chords and swelling of the facial muscles. The specific name is sometimes erroneously spelled "seguine."

HETEROPSIS JENMANI Oliv. SURINAM: swamp, km. 1, vicinity of Base Camp, Tafelberg Creek, *24120*. Previously considered endemic to British Guiana. Jenman, Hook. Ic. **20**: *pl 1949* (1890), writes: "The plant grows up the stems of trees, from which it sends down long aerial roots, which split into thin strips, form the most useful tying material the Indians employ."

Maguirea spathicarpoides A. D. Hawkes, gen. et sp. nov. Herba terrestris, erecta; caudex subterraneous, verticalis; radices crassae; foliae erectae, virides, coriaceae, ad basim conduplicatae; petiolus crassus, fortiter conduplicatus; lamina magna, glabra, obovato- vel lineari-lanceolata, breviter acuminata; nervus medius prominens; nervi secondarii adscendentes, numerosi, ad marginem confluentes; inflorescentia ex basi emergens, magna; pedunculus erectus, ad basim attenuatus; spatha viridis, coriacea, erecta, elliptico-lanceolata vel oblanceolata, involuta, ad apicem breviter cucullata, acuminata, ad basim leviter plicata, undulata; spadix ad spatham adnatus, parte apicali sterili excepta, in segmentum compressum redactus; flores feminei gemini, plus minusve oblongi; flores masculi 3–5 ad cuiusque floris feminei basim producti, sessiles vel leviter pedicellati, rectangulares; pars apicalis sterilis, libera, attenuata.

Erect terrestrial herb. Stem subterranean, vertical in soil, up to about 12 cm. long in our specimens, to 3 cm. in diameter, with numerous rough annular rings and a few fleshy roots. Foliage mostly erect, dark green (fide coll.), coriaceous when dry, apparently flaccid and rather fleshy when fresh, conduplicate and fleshier basally. Petioles to 32 cm. long, 6 cm.

across when expanded, but usually folded in two, about 3 cm. thick, fleshy. Blades (with petiole) to 10.9 cm. long, ca. 15 cm. wide, glabrous, obovate-lanceolate to almost linear-lanceolate, shortly acuminate at tip, with a very large (to 1.5 cm. wide toward base) median vein and numerous ascending secondaries which are confluent toward margins. Inflorescence arising from basal side of leaf-cluster, including the spathe up to 65 cm. long. Peduncle mostly about 1 cm. in diameter, usually somewhat narrowing basally, erect. Spathe light greenish (fide coll.), to 30 cm. long, 5–6 cm. wide below middle, coriaceous, erect, elliptic-lanceolate to somewhat oblanceolate, rather involute, slightly hooded apically, acuminate, a little plicate at base, undulate, especially toward tip. Spadix adnate to spathe, except for apical sterile portion, to ca. 16 cm. long and ca. 1 cm. or less across, reduced to a flattened segment with slightly raised margins on which the flowers are borne; female flowers paired (solitary toward base of spadix), more or less oblong in shape, ca. 5 mm. long, 3 mm. broad, and 2 mm. high; male flowers 3–5 at base of each female flower, sessile or slightly stalked, ca. 0.25 mm. high, rectangular when dry; sterile portion apical, free, of unknown length, narrower than fertile section.

TYPE: Bog terrestrial, Sectie O, vicinity km. 68, Surinam, October 19, 1944, *Maguire & Stahel 24998*, New York Botanical Garden.

This unusual new genus is apparently referable to the tribe Asterostigmateae, of the subfamily Aroideae, its closest described ally being Hooker's group *Spathicarpa*. I take great pleasure in dedicating this strange novelty to its discoverer, Bassett Maguire, of the New York Botanical Garden.

MONSTERA FALCIFOLIA Engl. BRITISH GUIANA: hemi-epiphyte rooted in ground and attached to tree by short adventitious roots from a *Bactris* palm in *Euterpe* swamp, leaves thinly fleshy, spathe fallen, spadix oblong in fruit, fruit hexagonal on surface, orange, Baramanni Creek, Waini River, N.W.D., *F2346*. The spathe of this species is typically yellowish. It is known from the Brazilian Amazon region, and Bolivia.

MONSTERA MILLERIANA Schott. BRITISH GUIANA: fleshy hemi-epiphyte with thick, 3–4 cm. diameter stem attached by short adventitious roots to *Spondias* tree from secondary forest but rooted in ground, leaf-bases clasping, petioles canaliculate, leaves thinly fleshy, flower spikes axillary, subtended by outer pair of amplexicaul, inner pair of sheathing bracts, spathe whitish, tightly rolled in bud, fruit spadix green-blue, oblong, Mabaruma, Aruka River, N.W.D., *F2473*. Probably endemic. Sometimes referred to *M. pertusa* (L.) DeVriese, but evidently distinct from that polymorphic species.

MONSTERA PERTUSA (L.) De Vriese. SURINAM: epiphytic on *Ceiba*, coastal jungle, near km. 60 along Carl Francois road from Paramaribo, *23601*. A highly variable species with several varieties, in Mexico, Central America, the West Indies, and much of South America.

MONSTERA PERTUSA (L.) De Vriese var. JACQUINII (Schott) Engl. SURINAM: a climber rooted in the soil, spathe cream-colored, white in bud, frequent, mixed forest, km. 10, Tafelberg Creek, *24083*; epiphyte, forest, east side, Savanna I, Zanderij, *25055*. Highly variable, with about the same distribution as the species.

MONTRICHARDIA ARBORESCENS (L.) Schott. SURINAM: Saramacca River banks, vicinity of Saron Creek, *23768*. A gregarious species found in the

West Indies, Central and South America, which grows principally along the edges of streams and rivers, in great clumps often to 3 meters or more high.

PHILODENDRON BROADWAYI N.E.Br. BRITISH GUIANA: climbing epiphyte, frequent, More forest, Kamuni Creek, Groete Creek, Essequibo River, *22862*. Also found in Tobago, Trinidad, and Venezuela.

Philodendron cyclops A. D. Hawkes, sp. nov. Planta scandens, robusta, epiphytica; caudex articulatus, magnus; petiolus cylindricus, ad apicem leviter attenuatus, ad basim expansus; lamina quam maxima, coriacea, pendens, utrinque glabra, leviter undulata, sagittato-elliptica, ad basim fortiter lobata ad apicem undulata, acuta; lobi posteriores magni, ovato-triangulares; obtusi vel truncati; nervus medius magnus, nervi laterales 2, obliqui, adscendentes; nervi secondarii ca. 8, leviter arcuati, ad marginem evanescentes; pedunculus erectus, 2 (vel plures?), ex vagina apicali orientes, leviter arcuatus, teres; pedicellus erectus, ad basim spathae expansus; spatha erecta, geminata, convoluta, ovato-lanceolata vel lanceolata, fortiter acuta, coriacea, rigida; spadix erectus, angustus, ad basim incrassatus.

Robust epiphytic vine. Stems climbing, of unknown length, prominently jointed, ca. 3 cm. in diameter, with a tan, flaky bark and often with rigid portions of the old leaf-petioles attached. Petioles apparently cylindric, narrowing slightly at apex and broadening basally, 57 cm. long and about 1 cm. in diameter in our specimen. Leaf-blade very large (only one present), 63 cm. long, ca. 33 cm. across near middle, apparently rather coriaceous, probably pendent, glabrous on both surfaces, very slightly undulate on margins, sagittate-elliptic, with two deep basal lobes and a gradually acute apex which is evidently more prominently undulate than the rest of the blade; basal lobes very large, rather ovate-triangular, with an obtuse or truncate apex, 21.5–23.0 cm. long, 18–19 cm. across; median vein very large, ca. 7 mm. across near base, giving rise to two obliquely ascending veins which extend to apex of lateral lobes; secondaries ca. 8 on each side, only slightly arcuate, disappearing toward margins; tertiary veins rather prominently raised, mostly parallel to margins. Peduncles erect, two (or more?) together from apical sheath, slightly curved, ca. 20 cm. long and 5 mm. in diameter, broadening at base and apex, apparently cylindric. Pedicels erect, ca. 4 cm. long and 5.5–6.0 mm. in diameter, widening toward junction with base of spathe. Spathe erect, double, the two sections rather tightly folded around each other and apparently not opening very much to expose the spadix, 15.5–17.5 cm. long, ca. 2.0–2.5 cm. in diameter, ovate-lanceolate or lanceolate, sharply acute at apex, coriaceous, rigid on drying. Spadix erect, ca. 15 cm. long, slender, ca. 12 mm. in diameter near base, 9–10 mm. in diameter toward apex, with a rather prominent bulge (sterile portion) above female inflorescence which reaches 14 mm. in diameter; female portion ca. 5.5 cm. long; male portion (including sterile area) ca. 9 cm. long.

TYPE: epiphyte, forest, east side Savanna I, Zanderij, Surinam, October 20, 1944, *Maguire & Stahel 25052*. New York Botanical Garden.

A large and spectacular epiphytic species, among the most robust of the genus, with great horticultural possibilities.

PHILODENDRON DEMERARAE Gleason, vel aff. BRITISH GUIANA: epiphyte, leaves sagittate, Kaieteur Plateau, *23412*. Apparently endemic.

PHILODENDRON LACINIATUM (Vell.) Engl. SURINAM: epiphyte, climbing

on rocks, or terrestrial, frequent, high forest, base south cliffs, Arrowhead Basin, Tafelberg, *24483*. This highly variable plant, found as well in British Guiana and Brazil, has characteristically deeply-lobed foliage and often attains large dimensions.

PHILODENDRON NOBILE Bull. BRITISH GUIANA: epiphyte, spathe white outside, crimson within, frequent, Kaieteur Plateau, *23409*; epiphyte, Kaieteur Plateau, *23412a*. SURINAM: terrestrial or epiphytic, spathe bright orange-red within, whitish outside, spadix white, frequent, high mixed forest northeast of Savanna II, Tafelberg, *24405*. A very showy aroid, with immense elongate oblanceolate leaves which superficially resemble those of the fern *Asplenium Nidus* L.; also known from Brazil.

PHILODENDRON SURINAMENSE Engl. BRITISH GUIANA: hemi-epiphyte rooted in the ground clinging to tree by short adventitious roots from a *Euterpe* in *Euterpe* swamp, leaves thinly fleshy, with winged canaliculate petioles, spathe green, tightly enclosing spadix except tip, spadix male flowers creamy-brown, female green, Baramanni Creek, Waini River, N.W.D., *F2343*. A little-known species, previously recorded only from Surinam.

PISTIA STRATIOTES L. BRITISH GUIANA: wallaba forests, Bartica-Potaro Road, *23561*. A rather small phase of this cosmopolitant acquatic aroid.

RHODOSPATHA LATIFOLIA Poepp. BRITISH GUIANA: climbing epiphyte, Mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22883*. Also known from Peru and Brazil; a showy species.

RHODOSPATHA SPRUCEANA (Schott.) Macbr. BRITISH GUIANA: epiphyte, leaves fleshy, spadix pale orange, occasional, wallaba forest, Kaieteur Plateau, *23328*. Previously found in Peru, Brazil, and Colombia.

SPATHIPHYLLUM CANNAEFOLIUM (Dryand.) Schott. BRITISH GUIANA: perennial fleshy tufted herb of *Manicaria* swamp, material is larger in all parts than that normally encountered in the swamp forest, leaves erect on long stalks, spathe open, green on reverse, white, glossy on upper face, spadix pale cream, Mabaruma, Aruka River, N.W.D., *F2388*. A showy species which is occasionally cultivated, indigenous to Trinidad, Venezuela, Colombia, and probably Brazil.

STENOSPERMATUM SPRUCEANUM Schott. SURINAM: terrestrial, inflorescence nodding, spathe white, infrequent in high forest, base of south cliffs, Arrowhead Basin, Tafelberg, *24459*; climbing epiphyte, spathe white, high forest, 300 m. south-east Ridge, Tafelberg, *24556*. Also known from British Guiana, Brazil, Peru, and Colombia. A showy and attractive plant.

SYNGONIUM TERNATUM Gleason. SURINAM: spathe yellow, frequent epiphyte, primary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22800*. Previously reported only from British Guiana.

UROSPATHA SAGITTIFOLIA (Rodsch.) Schott. BRITISH GUIANA: terrestrial, inundated river-banks, spathe chocolate-colored, rare, Potaro River, Kaieteur Plateau, *23393*. Also known from French Guiana and Brazil. A strange and spectacular aroid, exhibiting a predilection for a semi-aquatic habitat.

XYRIDACEAE[111]

XYRIS DOLICHOSPERMA Lanj. BRITISH GUIANA: locally frequent, from damp sand, Kaieteur Plateau, *23234*; locally frequent from boggy places,

[111] By J. Lanjouw and J. C. Lindeman.

Kaieteur Plateau, *23317*. SURINAM: grass savanna near Zanderij II, *23647;* locally frequent, border of seeps, with *Commelina, Drosera* in *Sphagnum*, Savanna VIII, Tafelberg, *24528*. This species seems to be rather common both in British Guiana and in Surinam.

XYRIS SURINAMENSIS Spreng. BRITISH GUIANA: common in damp sand, Kaieteur Plateau, *23141*. SURINAM: frequent in grass savanna near Zanderij II, *23672;* South Savanna, vicinity Arawak village at Mata, *24980*. A common species in Guiana and the Amazon region.

XYRIS PARAENSIS Poepp. apud. Kunth. SURINAM: frequent in grass savanna near Zanderij II, *23674*. This species seems to be rather rare in Surinam.

XYRIS LONGICEPS Malme. SURINAM: frequent in wet savanna near Zanderij I, *23718;* wet open places on rock, Savanna III, Tafelberg, *24259;* frequent, wet sphagnum-filled cracks in rocks, Savanna IV, Tafelberg, *24395b;* frequent in grass savanna near Zanderij II, *23673*. This species is common in Surinam. It is remarkable that it has not yet been reported from British Guiana, though undoubtedly it must occur there too.

XYRIS ULEANA Malme. BRITISH GUIANA: locally frequent, from stream bed, Kaieteur Plateau, *23386*. SURINAM: infrequent in Savanna I, Tafelberg, *24202;* frequent on wet places with Cyperaceae on rocks in Savanna II, Tafelberg, *24259a;* frequent in cracks of rocks, bed of Lisa Creek, near falls, Tafelberg, *24384*. This rare species is apparently common on Tafelberg.

XYRIS SPATHACEA Lanj. SURINAM: common in grass savanna near Zanderij II, *23664*. A second record of this endemic species, collected not very far from the type locality.

XYRIS GLABRATA Griseb. BRITISH GUIANA: locally common in damp sand and shallow crevices, Kaieteur Plateau, *23164*.

Note: This specimen is somewhat doubtful. It differs from the typical *X. glabrata* in the following characteristics: Leaves with a rugulose surface in the sheathing part and with dentate-scabrous margins, sometimes with very short, stiff cilia and a sulcate lamina; peduncle and leaf glossy-red, 6–9 cm. long, in the upper part with a more or less scabrous carina and a rather blunt, 1 mm. long tip. In the rugose leaf-base and the glossy-red peduncle leaf the specimen resembles *X. surinamensis*. It may be it is a hybrid of the latter species with *X. glabrata.*

SURINAM: frequent on wet places with Cyperaceae, rocks, Savanna II, Tafelberg, *24277*. Frequent, wet open places on rocks, Savanna I, Tafelberg, *24203*. A rather common species in Surinam.

XYRIS GUIANENSIS: Steudel. British Guiana: locally frequent, sandy ground, sedge bog, Kaieteur Plateau, *23179*. SURINAM: frequent on cracks in rocks, Lisa Creek near falls, Tafelberg, *24385*. The specimens are comparatively small, 9–14 cm. high and with very narrow leaves, 0.8–1.1 mm. wide. A rather common species in Guiana and Brazil.

Xyris connosepala Lanjouw & Lindeman sp. nov. Species e stirpe *Xyridis guianensis* Steudel. Caespitosa, radicibus tenuissimis. Folia complanata, 3–5 cm. longa, 0.2–0.7 mm. lata, apice acutiusculo, aciebus cartilagineo-incrassatis, in juventute ciliis minimis ornatis; vagina quintam vel quartam partem folii occupanti, ligula 0.4–0.6 mm. longa, acuta ornata, hyalino-marginata, eciliata, superne lamina nonnihil latiori, inferne paulo

dilatata. Scapi teretes, gracillimi, 12–22 cm. alti, ca. 0.25 mm. crassi, laeves, basi folio involuti ceteris longitudine aequante, longevaginata laminaque 7–11 mm. longa. Spica vulgo 2–3-flora, fusiformis, 4.0–5.5 mm. longa, 1.5–2.0 mm. crassa; bracteae infimae ovato-oblongae, ca. 3 mm. longae et 1.2 mm. latae, obtuse carinatae, area dorsali longa ornatae, obtusiusculae, bracteae secundae ovato-oblongae, ca. 3.5 mm. longae, ecarinatae, area dorsali magna, lanceolata, 3 mm. longa ornatae, obtusae, ceterae lanceolatae, naviculares, ca. 4.2 mm. longae, area dorsali 2 mm. longa ornatae, obtusae. Sepala lateralia postice in parte tertia vel quarta inferiore connata, subequilateralia, lanceolata, ca. 4.3 mm. longa, junctim 1.2 mm. lata, in parte media anguste serratulo-carinata, obtusiuscula. Ovarium uniloculare, oblongum, ca. 2 mm. longum, placenta basali-centralis, funiculis longis. Semina fusiformia, 0.5 mm. longa, 0.2 mm. lata, longitudinaliter striata, fusca.

TYPE: Surinam: frequent in wet sphagnum-filled cracks in rocks, Savanna IV, Tafelberg, Aug. 16, 1944, *Maguire 24395a.* Utrecht, New York Botanical Garden.

A remarkable new species related to *X. guianensis* and *X. filiscapa* in its vegetative parts, to *X. subuniflora* in the connate sepals.

XYRIS JUPICAI L. C. Rich. BRITISH GUIANA: locally frequent on rocks by river, Potaro River Gorge, Amatuk Portage, *23023;* locally occasional, aquatic tufted perennial, Kaieteur Plateau, *23235.* SURINAM: frequent in flowing water, Geyskes Creek, Camp No. 5, Coppename River Headwaters, *24833;* in wet sand, savanna vicinity, Sectie O, km. 68, *25013;* wet sand savanna, Zanderij II, *25036.* A very common American species.

ANNONACEAE[112]

UNONOPSIS GUATTERIODES (A.D.C.) R.E.Fr. *Anona peduncularis* Steud. SURINAM: scandent shrub, infrequent, Saramacca River, vicinity Brokolonka, *23793.* British to French Guiana, North Brazil (States of Amazonas, Pará, and Maranhão).

UNONOPSIS GLAUCOPETALA R.E.Fr. SURINAM: tree 7 m. high, 1 dm. in diameter, flowers green, very fragrant, border pina swamp, Saramacca River Headwaters, vicinity of Krappa Camp (No. 2), *24124.* Known also from British Guiana.

CYMBOPETALUM BRASILIENSE (Vell.) Benth. SURINAM: infrequent, Saramacca River, along railroad near km. 70, *23609;* wallaba forest along Tafelberg Creek, vicinity of Base Camp, *24096.* Trinidad, Venezuela, British Guiana, Surinam, Brazil south to Rio de Janeiro.

XYLOPIA AMAZONICA R.E.Fr. SURINAM: tree 5 m. tall, 15 cm. in diameter, bark thin, reddish, longitudinally scaling, buttressed, flowers white, mixed wallaba forest, km. 22, Tafelberg, *24818.* Previously known only from the Amazon region of Brazil (Manáos).

ANAXAGOREA DOLICHOCARPA Sprague & Sandw. SURINAM: small tree, 8 m. high, 10 cm. diam., petals fleshy, brown outside, cream within, primary jungle to rear of village of Posoegronoe, Saramacca River, *24021;* frequent in low dense wallaba forest, Tafelberg Creek, vicinity of Base Camp, *24097;* infrequent, fruit cream-colored, stipe reddish, cauliflorous, southern

[112] By Robert E. Fries.

rocky slopes of Arrowhead Basin, Tafelberg, *24605*. East Colombia and Venezuela, all Guianas, and Brazil south to Bahia and Rio de Janeiro.

GUATTERIA CHRYSOPETALA (Steud.) Miq. *Anona chrysopetala* Steud. SURINAM: frequent, along rim of Arrowhead Basin, Tafelberg, *24430*. The type is known only from Surinam, two varieties from French Guiana and North Brazil (Pará).

GUATTERIA GRACILIPES R.E.Fr. SURINAM: frequent, tree 5 m. high, 5 cm. diam., fruit turning purple-black, receptacle and pedicels red, Tafelberg, 1.5 km. south of East Ridge, *24589*. Previously known only from North Brazil (State of Pará).

GUATTERIA UMBONATA R.E.Fr. BRITISH GUIANA: from bush island in savanna, occasional, Kaieteur Plateau, *23121*. Previously known only from the state Pará of Brazil.

GUATTERIA PROCERA R.E.Fr. SURINAM: tree 12 m. high, 15 cm. diam., flowers greenish, in high mixed forest, Tafelberg, below cliffs of west escarpment, *24684*. Previously known only from Essequibo River in British Guiana.

GUATTERIA SCHOMBURGKIANA Mart. SURINAM: overhanging cliffs, west escarpment, Tafelberg, *24683*; frequent, tree 18 m. high, 25 cm. diam., mixed transition high-low bush, 5 km. s. w. Savanna No. 1, Tafelberg, *24781*. British Guiana, Surinam, and North Brazil.

GUATTERIA SCANDENS Ducke. BRITISH GUIANA: occasional in mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22941*. SURINAM: infrequent; high climbing rope, cauliflorous, flowers yellow-green, anthers orange, fruit red, swampy bush to rear of village of Kwatta hede, Saramacca River, *23916*. British Guiana to French Guiana, State of Pará in North Brazil.

DUGUETIA MEGALOPHYLLA R.E.Fr. BRITISH GUIANA: Takutu Creek to Puruni River, Mazaruni River, *F2090* (*F.D. 4826*). The description of this new species, based on the same number, is published this year in Kew Bulletin.

DUGUETIA CALYCINA R.Ben. SURINAM: gorge below Augustus Falls, North Ridge Creek, *24758*; south base of Table Mountain, Tafelberg, *24820*. Guiana and North Brazil (Pará).

DUGUETIA INCONSPICUA Sagot. SURINAM: shrub to 1.5 m. high, flowers white, below cliffs of west escarpment in high mixed forest, Tafelberg, *24685*. British to French Guiana.

DUGUETIA NEGLECTA Sandw. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River in high mixed forest, *22818*; *22899*. Known only from British Guiana.

DUGUETIA PYCNASTERA Sandw. BRITISH GUIANA: infrequent, opening in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22889*. Known also from Surinam.

ANNONA SYMPHYOCARPA Sandw. BRITISH GUIANA: rare, tree 6 m. high, 15 cm. diam., bush island, Kaieteur Plateau, *23443*. Previously known only from Demerara and Essequibo Rivers, British Guiana.

ANNONA HAEMATANTHA Miz. SURINAM: rope, flowers purple, high forest, Arrowhead Basin, base south cliffs, Tafelberg, *24470*. British to French Guiana.

ROLLINIA EXSUCCA (Dun.) A.DC. BRITISH GUIANA: 100 feet high and

2 feet diam., secondary forest on white sand, Potaro River Gorge, trail from Tukeit to Kaieteur Falls, *23065*. West Indies (Trinidad), Venezuela, Guiana and North Brazil (Pará, Amazonas).

MONIMIACEAE[113]

SIPARUNA DECIPIENS A.DC. SURINAM: Saramacca River near Jacob kondre, *23885*. A rather common species.

SIPARUNA SPRUCEI A.DC. SURINAM: lower North Ridge Creek, Tafelberg, *24807*. New for Surinam. A remarkable new record of this rare species, hitherto only known from the Rio Uaupes in the northern Amazonian Brazil.

SIPARUNA GUIANENSIS Aubl. BRITISH GUIANA: frequent in forest, Essequibo River, Kamuni Creek, Groete Creek, *22886*. A very common species.

SIPARUNA sp. BRITISH GUIANA: locally common, small tree with brick red fruit with a strong unpleasant odor, on rocky lateritic soil from dolerite dyke, Potaro River, Garroway stream, *22997*. Material too incomplete for determination. Probably a new species.

DROSERACEAE[114]

DROSERA CAPILLARIS Poir. SURINAM: frequent, in *Sphagnum* along seeps, Savanna VIII, Tafelberg, *24432; 24486*. Southern United States to Guiana.

DROSERA CAYENNENSIS Sagot ex Diels. BRITISH GUIANA: common, leaves red, occasionally green in shade, flowers white, from beneath a bromeliad, savanna, Kaieteur Plateau, *23466*. Amazonian district, French Guiana.

DROSERA PUSILLA H. B. K. SURINAM: leaves bright red, common, wet sand in savanna, Zanderij II, *25035*. Venezuela, British Guiana. The most common *Drosera* species in Surinam.

CONNARACEAE[115]

ROUREA FRUTESCENS Aubl. BRITISH GUIANA: in mora and mixed forest, Essequibo River, Kamuni Creek, Groete Creek, *22910*. This species seems to be common both in French and British Guiana and in Trinidad. It has curiously enough still not yet been recorded for Surinam.

ROUREA SURINAMENSIS Miq. SURINAM: infrequent, river banks below rapids, Saramacca River, vicinity of Jacob kondre, *23832*. A common species in Guiana.

CONNARUS PERROTTETII (D.C.) Planch. SURINAM: Saramacca River, Tafelberg Creek, *24897;* Saramacca River, 3 km. above Boschland, *24041;* infrequent on river banks below rapids, Saramacca River, near Jacob kondre, *23823;* infrequent on river banks below rapids, Saramacca River, near Jacob kondre, *23815*. A common species in Guiana and the neighboring part of Brazil.

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[113] By J. Lanjouw and J. C. Lindeman.

[114] By G. J. H. Amshoff.

[115] By J. Lanjouw and W. van Zeist.

BURSERACEAE[116]

PROTIUM HEPTAPHYLLUM (Aubl.) March. var. BRASILIENSE Engl. SURINAM: vicinity of Arawak village of Mata, *24956*. Northern and eastern South America.

Protium Pullei Swart, sp. nov. Arbor ca. 12 m. alta. Ramuli robusti 4 mm. diam. teretes glabri fusci lenticellis oblongis ferrugineis minutis. Folia trifoliata 17(16–21) cm. longa glabra, petiolis robustis semiteretibus 4–5 cm. longis ad basim incrassatis demum transverse rimosis, petiolulis semiteretibus robustis utrinque subincrassatis 1 cm. longis terminalibus 2.25 cm. longis foliolis oblongo-ellipticis 11(7.5–13) cm. longis 5(3.75–5.5) cm. latis, ad apicem abruptius acuminatis, acumine sublineari 8(5–10) mm. longo 2.5 (2–3) mm. lato, ad basim cuneatis, margine integro coriaceis utrinque nitidis laevibus supra glaucescentibus infra viridibus nervis secundariis utrinque 11 nervis primariis et secundariis utrinque prominentibus. Inflorescentiae axillares breves pauce ramosae pauciflorae ca. 1 cm. longae. Ramuli teretes striati cum pedicellis teretibus flore aequilongis bracteis bracteolisque triangularibus obtusis densiuscule puberuli. Flores 5-meri. Calyx cupuliformis lobis oblongo-triangularibus acutis tubo aequilongis. Petala valvata oblongo-triangularia acuta apiculo inflexo carnosa. Stamina 10. Discus 10-lobus glaber. Pistillum glabrum ovario late ovoideo stigmate 5-lobo coronato.

TYPE: frequent, tree 12 m. high, 15 cm. diameter, exuding a pitch on trunk used by Indians to make fire, mixed transition high-low bush 5 km. s.w. Savanna 1, Tafelberg, Surinam, *Maguire 24784*. New York Botanical Garden.

Protium Pullei Swart closely resembles *P. attenuatum* (Rose) Urb. from the Lesser Antilles and *P. Icicariba* (DC.) March. from s.e. Brazil. It differs from both species by its constantly trifoliolate leaves and in that the acumen of the leaflets is three times as long as wide; moreover it differs from the former species by its clustered and few-flowered inflorescences and from the latter species by its semiterete robust transversely rimose petioles, its larger leaflets and its glabrous calyx and corolla.

Protium Pullei Swart is named in honor of Prof. Dr. A. A. Pulle, of Utrecht, who devoted his scientific career to the promotion of the research of the flora of Surinam and who recently retired from official duty.

PROTIUM TRIFOLIOLATUM Engl. BRITISH GUIANA: Kaieteur Plateau, along Potaro River above Kaieteur Falls, *23533*. Equatorial South America, east of the Andes.

TRATTINICKIA BURSERIFOLIA Mart. BRITISH GUIANA: bush island, Kaieteur Plateau, *23209*. SURINAM: Saramacca River, trail to rear of village of Pakka Pakka, *23970A*; opening in rocky area, low Clusia-bush, between Camps no. 2 and 1, Tafelberg, *24641*. Equatorial South America, east of the Andes.

MELIACEAE[117]

TRICHILIA SUBSESSILIFOLIA C. DC. SURINAM: tree 12 m. high, 15 cm. in diameter, flowers white, low forest, frequent, Tafelberg, *24195*; tree 15 m.

[116] By J. J. Swart.
[117] By G. J. H. Amshoff.

high, 20 cm. in diameter, flowers white, on line, vicinity Blackwater Camp (5), Coppenam River Headwaters, *24182* fl. July. French Guiana and Surinam; represented in British Guiana by the very closely allied (perhaps not specifically distinct) *T. Schomburgkiana* C. DC.

TRICHILIA ACARIAEANTHA Harms. SURINAM: small tree, fruit turning yellow, inner pericarp bright red, high bush, base north escarpment, Tafelberg, *24182*. Surinam (collected in the forest reserves Sectie O, Zanderij I and Brownsberg) and British Guiana (Essequibo River region, *F. D. 2478* and *4023*).

ERYTHROXYLACEAE[118]

ERYTHROXYLUM CITRIFOLIUM St.-Hil. SURINAM: shrub or small tree, flowers greenish, savanna vicinity Sectie O, km. 68, *25023*. Central America, northern South America. Probably throughout the country.

VOCHYSIACEAE[119]

QUALEA ALBIFLORA Warm. SURINAM: tree 25 m. tall, 50 cm. in diameter, petals white with a yellow central line, high mixed wallaba forest, base of talus, Tafelberg, *24841*. Guiana, Amazonian district.

VOCHYSIA TETRAPHYLLA (G. F. W. Meyer) DC. SURINAM: tree, flowers yellow, overhanging Toekoemoetoe Creek, *24917*. Frequent throughout Guiana, along rivers.

AQUIFOLIACEAE

ILEX JENMANII Loes. SURINAM: tree 10 m. high, vicinity Arawak village Mata, Zanderij I, *24954*. British Guiana. Collected in Surinam in the forest reserves Zanderij I and Sectie O, and along the Coppenam River.

OCHNACEAE

ELVASIA ESSEQUIBENSIS Engl. BRITISH GUIANA: tree 12 m. tall, 12 cm. diam., common, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22934*. Apparently restricted to British Guiana.

POECILANDRA RETUSA Tul. BRITISH GUIANA: tree 4 m. high, 4 cm. diam., flowers yellow, occasional Kaieteur Savanna, *23186*; *23186a*. Generally distributed in the Guiana Highland of Venezuela and British Guiana.

Ouratea decagyna Maguire, sp. nov. *O. polygyna* sensu Wehlburg, Fl. Surinam **3**: 335. 1937; non Engler, Fl. Bras **12**²: 342. 1876. Arbor mediocris; laminis ellipticis vel oblongo-ellipticis, apicibus brevi-acuminatis, subconduplicatis, basibus subacutis vel obtusis, marginibus obsolete serrulatis; paniculis late pyramidalibus, dense floriferis; alabastris ovoideis magnis; floribus magnis, carpidiis 10; receptaculis disciformibus; drupis late ellipsoidalibus.

Medium-sized non-buttressed tree with smooth bark and hard red wood; leaf blades (4) 5–7 cm. broad, (8) 10–18 cm. long, elliptic to oblong-elliptic, the apex short-acuminate, subconduplicate, the base subacute or obtuse, the margins obsoletely serrulate, lateral veins numerous, indistinct, the primary about 10 (pairs), arcuate, midrib prominent, petioles 8–10 mm. long; panicle 8–15 cm. long, broadly pyramidal, densely flowered; buds ovoid 8–10 mm.

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[118] By G. J. H. Amshoff.

[119] By F. A. Stafleu.

long, 4-5 mm. broad; flowers yellow, fragrant; sepals 10–12 mm. long, 5–6 mm. broad, lanceolate; petals 14–16 mm. long, 10–12 mm. broad, obovate-spatulate; anthers 10, sessile, 9–10 mm. long, ca. 1.5 mm. wide at the base, tapering to a beak 0.5 mm. wide, transversely rugose; carpids 10; style 9–11 mm. long, contorted; receptacle fleshy, disciform, red, its symmetry dependent upon the number of carpids developing; drupes 6–8 mm. long, broadly ellipsoid, purple.

TYPE: tree 20 m. tall, 3 dm. diam. not buttressed, bark smooth, wood red, hard, flowers yellow, fragrant, mixed montane forest, km. 4, Saramacca River Headwaters, July 17, 1944, *Maguire 24128*. New York Botanical Garden. Cotypes: tree 20 m. high, 40 cm. diam., leaves dark green, flowers yellow, mixed high montane forest, North Ridge, Tafelberg, *Maguire 24805;* tree 25 m. tall, 4 dm. diam., flowers yellow, fragrant, receptacle red, fruit purple, frequent, mixed Wallaba forest, km. 19, Coppenam River Headwaters, Sept. 23, 1944, *Maguire 24835*. In addition to the type collections, apparently *B.W. 6880*, Brownsberg, Surinam, cited under *O. polygyna* in the Fl. Surinam (l.c.), belongs here. Unquestionably this species is closely allied to *O. polygyna* of Bahia, Brazil, because of the ten-carpellate ovary common to both. No specimen of *O. polygyna* has been seen. A comparison of our new species with it must therefore be drawn from Engler's[120] detailed original description and plate.

	O. polygyna	*O. decagyna*
leaves	2.5–3.5 × 10–15 cm. ratio approx. 1: 4	(4) 5–7 × 8–18 cm. ratio approx. 1: 2.4
bud	4–5 mm. long	8–10 mm. long
sepals	5 mm. long	10–12 mm. long
petals	5–6 mm. long	14–16 mm. long
anthers	4 mm. long	7–10 mm. long
style	4 mm. long	12 mm. long

A consideration of these figures forces the conclusion that the Surinam plants are specifically distinct, for the discrepancy in flower size is clearly much beyond the tolerable range of species variation in *Ouratea*. And not only is the leaf of *O. decagyna* relatively twice as broad as that of *O. polygyna* but it is definitely of a different shape, broadly elliptic to elliptic-oblong as against dedidedly lanceolate, as inspection of plate 69 (op. cit.) clearly shows.

Ouratea Gillyana (Dwyer) Sandwith & Maguire, comb. nov. *Kaieteuria Gillyana* Dwyer, Bull. Torrey Club **70**: 51. Ja 1943; *Ouratea cernuiflora* Sandwith, Jour. Arnold Arb. **24**: 225. Ap 1943. BRITISH GUIANA: shrub 1.5–2.0 m. high, inflorescence, calyx, and fleshy globose receptacle crimson, carpids globose, pale brown, finely tuberculate, 1–5 developing, frequent on bush islands, Kaieteur Savanna, *23172*.

Dwyer, in the January issue of Bulletin of the Torrey Botanical Club (l.c.), proposed the genus *Kaieteuria* based on *Jenman 863* from Kaieteur as distinct from *Ouratea* because of "striking" flower and fruit differences, viz. (1) that the calyx consists of 2 or 3 sepals which are fused in bud, and are "torn apart" during anthesis, and (2) that, "In fruit, the torus

[120] Fl. Bras. **12**[2]: 342, *pl. 69*. 1876.

becomes lignose, scarcely expands and bears a single drupe encased in the two persistent sepals."

Likewise based upon the same collection, *Jenman 863* (and *Jenman 1210*), Sandwith, little more than three months later (Jour. Arnold Arb. l.c.) proposed a new species under the genus *Ouratea* as *O. cernuiflora.*

It is obvious then that whichever may be the proper generic assignment of this species, the specific epithet *Gillyana* takes precedence.

The calyx character of the Kaieteur shrub is indeed striking, but is one that is not completely anomalous in the genus *Ouratea*, as was previously pointed out by Sandwith, who wrote of it (p. 226, l.c.): "An outstanding species of *Ouratea* on account of the ascending axillary [or terminal] racemes with nodding flowers on recurved pedicels and the very peculiar calyx with completely fused and indistinguishable sepals ruptured at the time of flowering into 2 or 3 concave coriaceous lobes. A tendency to a gradation toward this phenomenon can be observed in certain other species, for instance, on some specimens of *O. acuminata* (DC.) Engl. in which the inner sepals adhere so closely to the coriaceous outer members that their broadly scarious free margin cannot be separated and distinguished without dissection and examination of the inner side of the whole calyx." It may be further observed that this "rupturing" or "splitting" is not an irregular parting of the tissues as a result of pressure from within, but a regular dehiscence along the connate margins of the sepals.

The other differences cited by Dwyer, as is now evident from field observation and further collected material, do not obtain. Persistent sepals commonly occur in a number of species of *Ouratea*. At maturity the receptacle of this species under question is fleshy, and may be expanded to as much as 5 mm. in diameter. Commonly a single drupe does mature, as stated by Dwyer, but a single developed carpid is of common occurence among many species of *Ouratea*. However, frequently in specimens of the Kaieteur species several or often 5 carpids mature, exhibiting a variability in this regard that is generally found in the genus.

As a consequence, in review of the problem, Mr. Sandwith adheres to his earlier assignment of this species to the genus *Ouratea*. I concur in this disposition; accordingly we join in the necessary transfer of *Kaieteuria Gillyana* to *Ouratea Gillyana.*

OURATEA GUIANENSIS Aubl. BRITISH GUIANA: shrub to 2 m. high, branches few, horizontal, flowers yellow, mature fruit black, receptacle swollen, yellowish, on white sand, mixed forest, Kangaruma, Potaro River, *22993*. SURINAM: small tree, petals pale yellow, anthers deep yellow, Tafelberg Creek, Saramacca River Headwaters, *24085;;* shrub or small tree, flowers yellow, vicinity Blackwater Camp, (5) Coppenam River Headwaters, *24171*. British Guiana to Amazonian Brazil.

Additional collections from British Guiana are to be referred here: Potaro River, *Gleason 125, 224, 227, 245, 246,* and *248;* Mazaruni River, *Leng 238;* on all of these sheets Mr. N. E. Brown made the following annotation " = *Jenman 1100*, from Waraputa cataract." On *Gleason 125* Brown further wrote: "This *Ouratea* is very much like Aublet's type of *O. guianensis,* with which I have this day compared it, but it differs from that species by its leaves being more cuneate at the base, the veins rather

more numerous, and the infloresence rather less branched. N. E. Brown Feb. 28, 1923."

Surinam material is variable, the leaves attaining dimensions of 13–45 cm., with decidedly finely serrate margins. These conditions would seem to bridge the gap between *O. guianensis* as interpreted here and the Brazilian *O. gigantophylla.* But leaves of the Brazilian species have deeply and conspicuously impressed veins, and stand very distinctly apart from those of *O. guianensis.* Even so certain specimens of the latter from British Guiana, notably *Gleason 227,* and *248* from the Potaro River have more than a suggestion of the impressed vein character. The Guiana plants seem to be even closer to *O. tarapotensis* Macbr. of the Amazonian Peru.

Mr. Sandwith has suspected (in correspondence of Aug. 5, 1948) that the British Guiana material, at least, may be referable to *O. longifolia* (DC.) Engl., but he has not had the opportunity to examine the type of that binomial nor that of *O. guianensis.*

A better understanding and more adequate material of these populations my demonstrate them to constitute a single widespread and polymorphic species. Moreover, adequate typification is necessary before any of the specimens here cited may be definitely assigned.

OURATEA SCHOMBURGKII (Planch.) Engl. BRITISH GUIANA: shrub 10 feet high, Iteballi Falls, Essequibo River, *F 1669* (*F.D. 4405*); shrub to 20 feet high, 6 inches diam., rocky island, Marshall Falls, Mazaruni River *F2689* (*F.D. 5482*); tree 20 feet high, 3 inches diam; Ituribisi Lake, Essequibo coast, *F2697* (*F.D. 5472*). SURINAM: tree, torus red, river bank, Saramacca River between Jacob kondre and Kwatta hede, *23901;* shrub or small tree, floral axis and torus red, fruit black, full exposure, small open island, Saramacca River between Kwatta hede and Pakka Pakka, *23954.* Amazonian Brazil, Surinam, British Guiana.

Mr. Sandwith has examined *F.D. 4405,* and *23954,* of which he writes; "*F.D. 4405* [is] in my opinion certainly *O. Schomburgkii* (Planch.) Engl. We have authentic material and several other sheets. Surely *Maguire 23954* is also probably *I. Schomburkii!* The leaves and infloresecence match extremely well. We have type-number material of Ule's *O. racemiformis* [to which I had referred the specimens in question], *Ule 7991,* and I have identified it in the past as *O. Schomburgkii;* and see no reason to alter my opinion."

In acknowledgement of Mr. Sandwith's judgement the specimens cited above are referred to *O. Schomburgkii.* In the same light it would seem also that *O. racemiformis* must become a synonym of *O. Schomburgkii.*

OURATEA cf. O. *roraimae* Engl. BRITISH GUIANA: shrubs 2 m. high, 1–2 cm. diam., flowers yellow, fruit (immature) green, torus crimson, occasional sedge bogs and bush-island fringes, Kaieteur Savanna, *23147; 23147a; 23147b;* shrub of scrub savanna, to 6 feet high, on white sand, Ituni-Road, Mackenzie, Demerara River, *F2495* (*F.D. 5231*). Savannas, British Guiana and southern Venezuela.

OURATEA SURINAMENSIS (Planch.) Wehlburg. SURINAM: shrub to 2 m. high, bark grayish-brown or brown, tending to exfoliate, flowers yellow, torus dark red, carpids grayish, minutely rugulose, frequent, Savanna II, Tafelberg, *24249;* Savanna IV, Tafelberg, *24389a, 26175.* Known only from Surinam.

SAUVAGESIA ERECTA L. BRITISH GUIANA: perennial herb to 30 cm. high, Garraway Stream, Potaro River, *22792*. SURINAM: frequent annual, Charlesburg Rift, 3 km. north Paramaribo, *22744;* annual or short-lived perennial, stony stream side, Blackwater Camp (5) Coppenam River Headwaters, *24190;* perennial herb, petals pale pink, stamens and stamenodes red, mossy banks, lower Augustus Creek, Tafelberg, *24733*. Widespread, West Indies and tropical America; reportedly pantropic.

SAUVAGESIA RORAIMENSIS Ule. SURINAM: annual, flowers white, base dripping cliffs, north escarpment, Tafelberg, *24193;* annual, flowers white, dry opening in low bush 1.5 km. south of Savanna I, Tafelberg, *24352;* annual, flowers white, openings in high bush vicinity Arrowhead Basin, Tafelberg, *24418*. Mt. Roraima, Venezuela (type locality), and Surinam. Otherwise reported in Surinam from Hendriktop and the Wilhelmina Range.

Our specimens are all definitely annual. The other material from Surinam is described as underbrush, 30–50 cm. high, and the type as "suffruticosa," the "stengel 3–5 dm. hoch." Nevertheless, in consideration of the extreme variability in habit that occurs elsewhere in the genus, the Tafelberg plants must be interpreted as *S. roraimensis*.

SAUVAGESIA SPRENGELII St.-Hil. BRITISH GUIANA: perennial suffrutescent herb, stems red, flowers pink, frequent, dry sandy soil, Kaieteur Savanna, *23202* (intermediate to *S. amoena* Ule). Surinam: flowers rose, frequent on white sand, Zanderij II, *23693;* perennial, petals white flushed with pink, frequent, Savanna I, Tafelberg, *24208*. Widespread, Trinidad and tropical South America.

The Kaieteur specimens are intermediate in habit and leaf character between the exceedingly polymorphic *S. Sprengelii*, and the geographically restricted *S. amoena*, suggesting that the latter may be only an extreme broad-leafed phase of *S. Sprengelii*.

CARYOCARACEAE

ANTHODISCUS MAZARUNENSIS Gilly. SURINAM: tree 25 m. high, 50 cm. diam., flowers yellow, corolla calyptroid, high bush, south rim Arrowhead basin, *24576*.

COMBRETACEAE

Buchenavia Fanshawei Exell & Maguire, sp. nov. Arbor mediocris; folia breviter petiolata, petiolo sparsissime minute pubescenti vel glabro; lamina oblanceolata apice breviter acuminato, basi acuto, glabra, haud conspicue lepidota, costis infra prominentibus; fructus sessilis oblongo-globosus, carnosus, juventute dense pubescens demum glabrescens.

Tree probably as much as 35 m. high and 50 cm. diam; leaves short-petioled, the petioles sparsely and minutely pubescent or glabrous, the blades 7–14 cm. long, (2.5) 3.5–6.0 cm. broad oblanceolate, the apex with a short blunt acumen, the base acute, glabrous not at all lepidote, the lateral veins 3–4 pairs, impressed in the upper surface, prominent on the lower; spikes axillary, 3–6 (12) cm. long, angled, pendant, tawny-pubescent, finally glabrescent; flowers not present in the type collection; drupes oblong-globose, 15–18 mm. long, fleshy, yellow, sparsely hirtellous, glabrate, 1–3

maturing; seed 12–15 mm. long, strongly ribbed lengthwise, pale cream, embedded in a transluscent mucilage.

TYPE: tree 10 m. high, 40 cm. diam., fruit oblong-globose, yellow, in pendant spikes, seed solitary, pale cream, embedded in transluscent mucilage; rare, riverside, Potaro River below Tukeit, British Guiana, May 16, 1944, *Maguire & Fanshawe 23199*. New York Botanical Garden; British Museum.

BRITISH GUIANA: tree 40 feet high, berry yellow, banks of Potaro River, Tumatumari, *Gleason 401*. In addition, almost certainly the following belong here: tree 12 m. high along river, Kuyuwini River, *Smith 3033;* from large relict tree in secondary forest, Mazaruni Station, towards Labbakabra Creek, *Sandwith 1219;* Kamakusa, upper Mazaruni River *la Cruz 3074;* tree 90 feet high, 16 inches diam. Mahdia River, Potaro River, Bartica-Potaro Road, *F1039* (*F.D. 3775*); tree 110 feet high, 20 inches diam., same locality, *F1064* (*F.D. 3800*).

The only flowering specimen at hand should be commented on more at length: tree 60 feet high, 10 inches diam., from secondary forest on brown sand; leaves young, when mature leathery, stiff, margins revolute, tufted at branch ends, flowers in axillary spikes, yellow-green, perianth shaped like a flat bowl, barely lobed, Mazaruni Station, *F1270* (*F.D. 4006*). The characterization of flowers of *F1270* is in all probability to be considered a part of the description of *B. Fanshawei:* flowers apetatous; patelliform, 3–4 mm. in diam. the low margins incurved, with about 10 inconspicuous lobes; stamens 10, inserted at three levels on the calyx tube, near the margin, at an approximately mid-way point, and near the base, the filaments ca. 2 mm. long, anthers elliptic, ca. 1 mm. long, introrse, substipitate, separated by a broad, deltoid connective; ovary broadly disciform-conic, densely tawny-tomentose, style ca. 1 mm. long, awl-shaped.

This species is characterized by its oblanceolate leaves with only 3–4 pairs of lateral nerves which are rather prominent on the lower surface, and join the midrib at an acute angle. In these characters it is closest to *B. ochroprumna* Eichl., which has however, smaller, more obovate leaves and fruit which retain a dense indumentum when mature. *B. grandis* Ducke has glabrous fruit similar to those of *B. Fanshawei*, but somewhat larger, and leaves of approximately the same size but with 6–7 pairs of nerves and a much closer reticulation.

COMBRETUM BRUNNESCENS Gleason. BRITISH GUIANA: vine, fruit green, occasional, Kaieteur Savanna, *23355*.

COMBRETUM CACOUCIA (Baill.) Excell. SURINAM: liana, sepals and petals green, tinged with pink, filaments red, along railway Sectie O, km. 70, *23623; 23642*. Widespread in tropical America.

COMBRETUM PYRAMIDATUM Desv. SURINAM: shrub or small tree 3 m. high, flowers white, infrequent, river banks below rapids, Jacob kondre, Saramacca River, *23809*.

COMBRETUM LAXUM Jacq. SURINAM: vine, flowers white, frequent Toekoemoetoe creek, Saramacca River, *24067*.

Terminalia quintalata Maguire, sp. nov. Arbor mediocris; foliis oblongo-obovatis vel oblanceolatis, subcoriaceis glabris, integris, petiolis brevibus, alato-marginatis; inflorescentiis spicatis, axillaribus; floribus sessilibus,

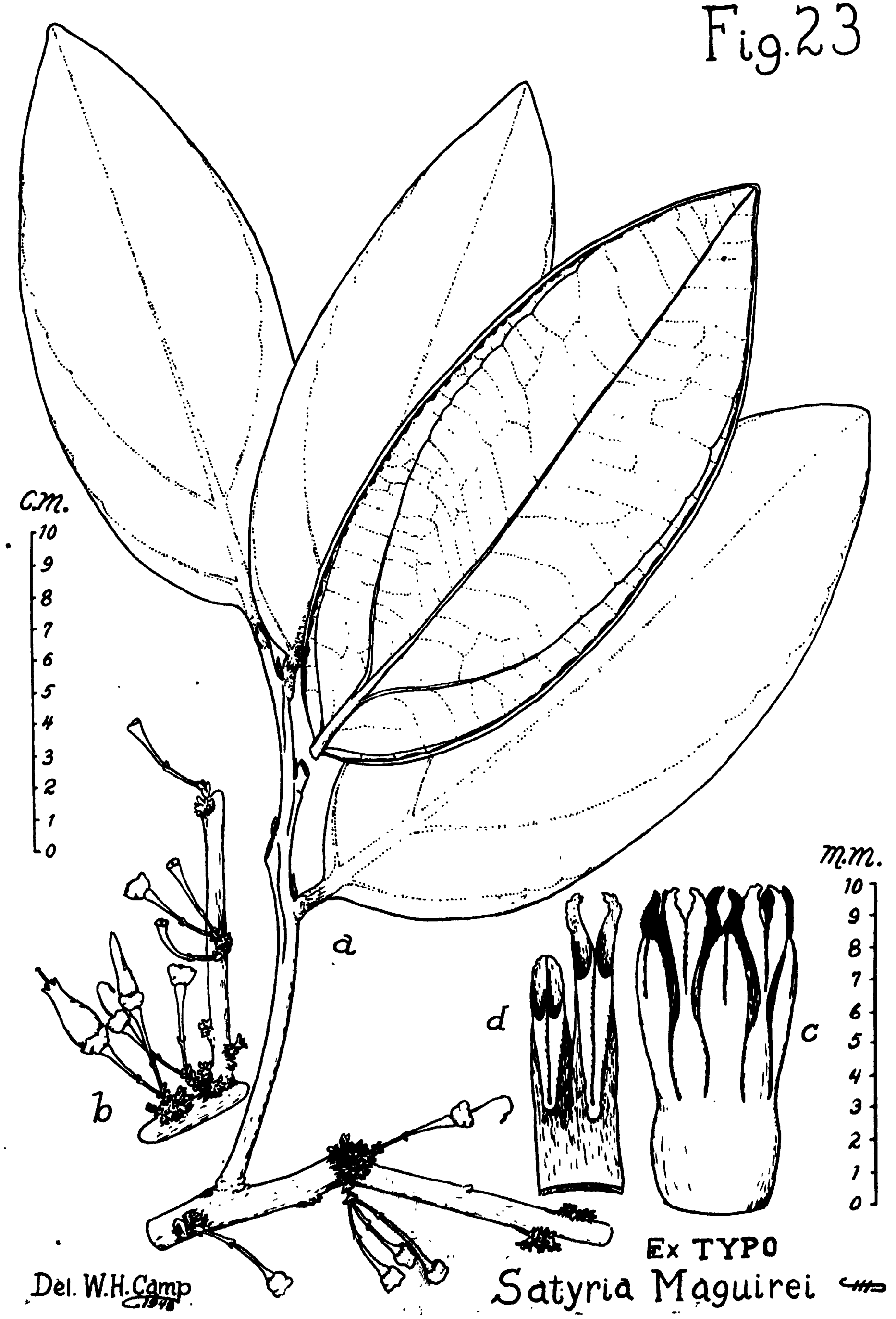
Fig. 23
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Ex TYPO
Satyria Maguirei
Del. W. H. Camp
1948

filamentis vix exsertis; fructubus parvis, late oblongo-ellipticis, aequaliter quinque-alatis.

Tree at least 25 m. high, 50 cm. diam.; leaves aggregated near the ends of the shoots, wing-petioled or the upper most subsessile, petioles to 1.5 cm. long, blade 10–15 cm. long (those subtending the inflorescences as little as 3 cm. long and 1.5 cm. broad), 5–9 cm. broad, oblong-obovate to oblanceolate, the apex rounded or obtuse, the base narrowed to the winged petiole, strongly chartaceous to subcoriaceous, glabrous, the veins inconspicuous on the upper surface, somewhat prominent on the lower; inflorescences axillary, spicate, 10–15 cm. long, minutely puberulent; flowers pentamerous, ovary densely tan-short-villous, the hypanthium goblet-shaped, 2.0–3.0 mm. long, puberulent, thinly pilose within, the fornices densely pilose, the 5 lobes ovate, acute, 1.0–1.75 mm. long; stamens 10, filaments white, awl-shaped, exserted by 1 mm. or less, anthers ca. 1 mm. long, apiculate, deeply cordate, versatile; style 3–4 mm. long awl-formed, ovules 2, pendant; fruit inclusive of wings 8–10 mm. long, about 8 mm. thick, the broadly oblong-elliptic wings equal, about 2 mm. wide.

TYPE: tree 24 m. high, 45 cm. diam., fruit winged, carmine, on erect spikes, locally frequent, Potaro River Gorge, below Amatuk Portage, British Guiana, May 19, 1944, *Maguire & Fanshawe 23551*. New York Botanical Garden. Cotype: tree 20 m. high, 25 cm. diam., buds white, locally frequent, forming pure clumps, low bush, vegetative branchlets coarse, ashy-gray, the flowering branchlet slender, Kaieteur Plateau, *23459*. The following sterile collection was likewise made on the Kaieteur Plateau: tree 5 m. high, Kaieteur Savanna, *23313*. Known only from the type region.

T. quintalata seems to be most closely related to *T. amazonia* (J. F. Gmel.) Exell [*T. obovata* (R. & P.) Steud.], but differs strongly in leaf, flower, and fruit characters. Its fruit is similar to that of *T. Oliveri* Brandis of Burma, but is only half as large.

ERICACEAE[121]

BEFARIA GLAUCA H.B.K. BRITISH GUIANA: Kaieteur Savanna, *23268*. As noted elsewhere, there seems little point in attempting to affix the varietal names recognized by others in this widespread and variable species since they seem to have little or no geographic correlation.

VACCINIACEAE[122]

NOTOPORA SCHOMBURGKII Hook. f. BRITISH GUIANA: Kaieteur Plateau, *23145, 23150*. These collections are from within the known general range of the species, this being British Guiana (primarily the Kaieteur Plateau) and parts of Brazil adjacent Mt. Roraima. A specimen from Auyán-tepui, Vene-

[121] By W. H. Camp.
[122] By W. H. Camp.

Explanation of figure 23

Satyria Maguirei Camp, sp. nov. From the type sheet, *Maguire 24474*, Herb. N. Y. Bot. Gard. a. Branch, one leaf removed and reversed, showing lower surface. b. Detached portion of old stem and branch. c. Stamens, with fused filaments and alternate five long and five short anthers. d. Adaxial view of a pair of anthers.

zuela, *Felix Cardona 257,* said to be this species, may be distinct. The differences between the present collections, noted on the tickets, seem to fall within the range of variability of this species as I understand it.

ORTHAEA APOPHYSATA (Griseb.) A. C. Smith. BRITISH GUIANA: Amatuk Portage, Potaro River, *23026;* Kaieteur Plateau, *23154.* Recorded as being a "rope" or liana. Up to about a decade ago this species was known only from the island of Trinidad, B.W.I.; in addition to the foregoing, there is before me a specimen (*Sandwith 1252*) collected at "Amatuk, Potaro River" in 1937, apparently from the same locality as one of these.

Satyria Maguirei Camp, sp. nov. Frutex scandens. Petiolus ad 15 mm. longus. Folia elliptica vel subovata, apice obtusa vel subacuta, basi rotundato, 12–22 cm. longa, 6–11 cm. lata, coriacea, subnitida, margine integra revoluta, 5-plinervia. Inflorescentia cauliflora, 1–6-flora, 5 mm. longa. Flores consimiles descriptioni et illustrationi *Satyriae carnosiflorae* Lanjouw (Rec. Trav. Bot. Néerl. **30**: 165–167, *f.1c-f.* 1933).

TYPE: Surinam: "frequent, flowers red; intermediate forest, south rim Arrowhead Basin," 725 m. Aug. 24, 1944, Tafelberg; *Maguire 24474.* New York Botanical Garden. Additional specimen; ibid. *Maguire 24429,* Aug. 21, 1944.

This material presents something of a problem. Upon dissection the flowers and flower parts proved to be so similar to the description and figures by Lanjouw for his *S. carnosiflora* that they might easily have been prepared from this material. On the other hand, his description and figures also indicate a plant with fairly long-acuminate leaf apices and axillary inflorescences up to 9 cm. long. The difference in leaf shapes of that material and this perhaps might not warrant the recognition of different species, but the difference in inflorescences is quite marked. Of the ten branch apices available to me for study in the type and additional collection, not a single one bears any evidence of axillary inflorescences. Instead, all of the various available inflorescences are cauliflorous; although morphologically in an axillary position, they seem to appear only after the attendant leaf has fallen, and on wood of the previous season or older. As is not infrequent in the cauliflorous Vacciniaceae, the individual inflorescences may increase in number at any given node until, on the old wood, they appear to form a cluster often associated with the massed bracts of previous inflorescences.

It is, of course, well known that certain of the lianoid Vacciniaceae bear flowers in ordinary axillary inflorescences and also on the old wood; this is even true of certain species of *Satyria.* However, in the great majority of instances where this is known to me there is a marked similarity between the inflorescences in the leaf axils on the new wood and those from the cauliflorous clusters on old wood. In the present instance the loose-flowered racemes of *S. carnosiflora* are said to reach 9 centimeters in length; in the cauliflorous, usually few-flowered inflorescences of the one here described, the longest rachis I could discover was only 5 millimeters long.

A somewhat similar situation is presented in succeeding paragraphs on *Vaccinium subcrenulatum* from British Guiana; however, in that instance the British Guiana Highlands (in connection with the associated areas in Venezuela) are the meeting place of several groups of related species, some of which have terminal and others axillary inflorescences, the latter of these being either long or short. The result is a genetic com-

plex exhibited in the variable inflorescences, apparently on the same plant, of the material from the Kaieteur Plateau. No such pool of species of *Satyria* is known from the highlands of Surinam capable of producing a similar genetic complex.

There are several possibilities; either two species of *Satyria* are present with similar flowers and dissimilar inflorescences and leaves (a common situation in the Vacciniaceae), or *S. carnosiflora* has considerably more variability in inflorescence and leaf characters than one usually thinks of in species of this genus. Also, it is not beyond the bounds of possibility that *S. carnosiflora* might have been based on a mixed collection.

SPHYROSPERMUM MAJUS Griseb. SURINAM: vicinity of Savanna VIII, 2 km. west of East Ridge, 786 m. alt., Tafelberg, *24565*. This appears to be one of the commoner species of the genus, being known from Guatemala and the West Indies southward into the Andes and Guiana Highlands.

THIBAUDIA NUTANS Kl. SURINAM: Tafelberg, *24268; 24473*. The tickets list this as a [bush] "rope," or liana. The Type (*Schomburgk 873*) is from Mt. Roraima and additional previous collections known to me which I would place here are *Pinkus 149*, also from Roraima, and *Holt & Blake 499* from Serra Imeri, Brazilian-Venezuela Boundary. Material reported as this from Auyán-tepui, Venezuela, is related but does not seem to be exactly equivalent.

THIBAUDIA ULEI (Mansf.) A. C. Smith. BRITISH GUIANA: Kaieteur Plateau, *23153*. Described on the ticket as a [bush] "rope." *Sandwith 1336*, from the Kaieteur Savannah, is from a "low pendant shrub." It is suspected that this plant is not a true climbing liana, or "bush rope," but a semi-scandent shrub. At higher elevations, material apparently of this species is lower-growing and more shrubby. This same change in habit among the Vacciniaceae has been noted by me in the field in Amazonian Ecuador; there on the eastern Andean escarpment at low elevations the plants of certain species sometimes are scrambling or long-pendant epiphytes, at the higher elevations they may be quite typical shrubs, sometimes less than a meter tall and growing on soil.

The type of *T. Ulei* (*Ule 40*) is from Mt. Roraima. The species has been previously collected on the Kaieteur Savanna; it also is known from Auyán-tepui in Venezuela. The least satisfactory material of *T. Ulei* and the foregoing (*T. nutans*) comes from Mt. Roraima. The material of *T. Ulei* from the Kaieteur Plateau (and Savanna) appears to be consistent and completely distinct from the currently reported material of *T. nutans* from Surinam. Taken as a group, the material known to me from Roraima appears to partake considerably of varying proportions of the genetic elements of these last two forms. The nomenclatural types of these two came from Roraima and, although different in appearance, also appear to be parts of what might be called the "Tepuia-complex" of this genus, which extends westward from Roraima onto Auyán-tepuia in Venezuela. The morphologically distinct (and biotypical) forms appear to be these from the Kaieteur Plateau in Britsh Guiana and Tafelberg in Surinam. In the present state of our disknowledge of the cytogenetics of these populations there would seem to be little point in nomenclaturally spliting this complex further on the basis of the available evidence. Some specimens have the appearance of hybrids and back-crosses; other related materials with coarse

leaves and larger flowers have much the appearance of polyploids. There is no reason to suspect that hybrid swarms and polyploids are biological phenomena limited to the North American segment of the Vacciniaceae (Camp, Brittonia 5: 203–275. 1945; etc.).

VACCINIUM SUBCRENULATUM Kl. BRITISH GUIANA: Kaieteur Plateau, *23167; 23385*. Of these two collections, the inflorescences of *23167* are axillary racemes, the shorter (ca. 3–7 cm. long) with minute bracts, the longer (up to 16 cm. long) with large leafy bracts as much as 20 mm. long and 7 mm. wide, these measurements being taken from material sufficient for 4 or 5 full herbarium sheets. I have split the material of *23385*, also sufficient for 4 or 5 sheets, into three parts for ease of reference, *23385a* has axillary racemes, these sometimes leafy, up to 6 cm. long; *23385b* has minute-bracted axillary racemes, the longest of which is 2.5 cm. long. *23385c* has a terminal minute-bracted, paniculate inflorescence (somewhat damaged in shipping); the main axis extends 10 cm. above the uppermost reduced leaves (the terminal portion obviously immature and not fully elongated); the lateral inflorescence branch preserved is 6 cm. long (also not fully developed). The leaves of *23385c* are crowded and appear to be diseased; the stem also appears to be unhealthy. *Pinkus 26*, from the upper Mazaruni River, and *Sandwith 1341* serve to fill in the gaps in the normal spread of variability of this typically Kaieteur Plateau species. The terminal inflorescence of *23385c*, which may be a pathological reversion, at least serves to indicate something of the relationship between the variable *V. subcrenulatum* Kl. and the more recently described *V. spathulatum* Camp & Smith and *V. tepuiense* Camp & Smith, both from Auyán-tepuia, Venezuela, which also seem to have both terminal and axillary inflorescences.

EBENACEAE[123]

DIOSPYROS DICHROA Sandwith. BRITISH GUIANA: tree 110 feet high, 20 in. diam., leaves fawn below when young, silvery when old, velvety-hairy, calyx stiff and fleshy, ovary hairy, fruit globose, hairy. Mahdia River, Potaro River, Bartica–Potaro Road, *F1016* (*F.D. 3752*).

DIOSPYROS GUIANENSIS (Aubl.) Gürke. BRITISH GUIANA: Essequibo River by Yakáramaro Creek, *F1347* (*F.D. 4083*). SURINAM: tree 15 m. high, 20 cm. diam., frequent on river banks above village of Kwatta hede, Saramacca River, *23931*.

DIOSPYROS LISSOCARPOIDES Sandwith. BRITISH GUIANA: tree 25 feet high, flattened stem, fruit axillary, solitary, calyx enlarged, stiff, Bartica Point, Mazaruni-Essequibo junction. *F1190* (*F.D. 3926*); Kauria Cree, lower Cuyuni River, *F1429* (*F.D. 4165*).

DIOSPYROS IERENSIS Britton. BRITISH GUIANA: tree 90 feet high, 16 inches diam., corolla tubular, whitish, fleshy, White Creek, Groete Creek, Essequibo River, *F1784* (*F.D. 4520*); 107 m. Bartica-Potaro Road, *F1500* (*F.D. 4236*).

DIOSPYROS TETRANDRA Hiern. Tree 10 m. high, 15 cm. diam., wood sap turning yellow, flowers white, mixed high forest, vicinity of Augustus Falls, Tafelberg, *24742*. Identified by G. J. H. Amshoff. In Surinam hitherto only collected in the forest reserve, Brownsberg.

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[123] By N. Y. Sandwith.

STYRACACEAE

STYRAX GUIANENSIS A. DC. SURINAM: small tree overhanging Lisa Creek, 300 m. above falls, Tafelberg, *24369;* frequent, tree to 15 m., 15 cm. diam., flowers white, leaves silvery beneath, rim of Arrowhead Basin, Tafelberg, *24416; 24424*. British Guiana, Amazonian district. First collection in Surinam. In the Tafelberg specimens, the leaves are smaller than in the typical form.

DICHAPETALACEAE[124]

TAPIRA GUIANENSIS Aubl. SURINAM: infrequent, tree to 3 m., 3 cm. diam., flowers greenish, on petioles, along railroad near km. 70, *23621*. Guiana, Amazonian district. Frequent throughout Surinam.

DICHAPETALUM PEDUNCULATUM (DC.) Baill. SURINAM: rope, fruit light tan, in trees overhanging stream, North Ridge Cascade, Tafelberg, *24669*. Guiana, Amazonian district. Throughout Surinam.

DICHAPETALUM VESTITUM (Benth.) Baill. SURINAM: rope, fruit velvety-brown, on tree overhanging stream, North Ridge Cascade, mixed high forest, Tafelberg, *24658*. Guiana, Amazonian district.

SOLANACEAE[125]

LYCIANTHES sp. BRITISH GUIANA: occasional, vine, flowers green, calyx lobes revolute, fruit scarlet, globose, 2 cm. in diam., on red loam, rocky ground, secondary forest, Potaro River Gorge, *23058*.

SOLANUM SCANDENS L. SURINAM: locally frequent, perennial herb, flowers pink, opening, base north escarpment, mixed high forest, Tafelberg, *23774*. This interpretation of *S. scandens* L. was given by Bitter, who in 1923 determined our Surinam specimens of *Solanum* L. I do not know whether Bitter examined the type, but though the description of Linnaeus in 1775 is very short, the more detailed description given by Linnaeus fil. in 1781 leaves no doubt about the correctness of Bitter's interpretation. Guiana, Brazil.

SOLANUM SCANDENS var. **laetum** (Miq.) Bitter, comb. nov. *Solanum laetum* Miquel, Stirp. Sur. Sel. 135. 1851; non *S. laetum* Kunze, 1842; *Solanum sempervirens* Dunal; DC. Prodr. **13**: 88. 1852; non *S. sempervirens* Mill. 1768. SURINAM: flowers purple, fragrant, anthers yellow, riverbanks above village, Kwatta hede, Saramacca River, *23939*. This variety, apparently not previously published, differs from the typical form by its glabrous or nearly glabrous leaves. The type of *Solanum laetum* Miq. is in the Utrecht herbarium; a duplicate of the type of *S. sempervirens* Dunal in Leiden. Surinam and British Guiana.

SOLANUM RUGOSUM Dunal. SURINAM: shrub, vicinity Jacob kondre, Saramacca River, *23804a;* shrub to 4 m. high, flowers white, anthers yellow, bush to rear of village Pakka Pakka, Saramacca River, *23966*. West Indies, Guiana.

SOLANUM SURINAMENSE Steud. BRITISH GUIANA: frequent, tree 12 m. high, 10 cm. diam., flowers white, petals thick, frequently only shrub, opening in high forest, Kamuni Creek, Groete Creek, Essequibo River,

[124] By G. J. H. Amshoff.
[125] By G. J. H. Amshoff.

22900. SURINAM: frequent, shrub to 10 m. high, flowers blue, fruit cream, Charlesburg Rift, open scrub land, 3 km. north of Paramaribo, *22802.* Guiana, Brazil, Colombia.

SOLANUM HOSTMANNI Dunal. SURINAM: frequent, shrub 2–3 m. high, flowers white, anthers yellow, partly submerged in rapids, along river between Jacob kondre and Kwatta hede, Saramacca River, *23898.* Frequent in Surinam from the Corantyne River to the Marowyne River. The name *S. Hostmanni* Dunal has been retained by Bitter in his determinations of 1923.

SOLANUM JAMAICENSE Mill. BRITISH GUIANA: subshrub to 1 m. high, leaves firm, chartaceous, fruit purple-black, on rocky lateritic soil, Garraway Stream, Potaro River, *22962.* West Indies, continental tropical America.

SOLANUM PALUDOSUM Moric. SURINAM: shrub to 4 m. high, flowers blue, anthers yellow, trail to rear of village, Pakka Pakka, Saramacca River, *23970.* British Guiana (compared with *A. C. Smith 3183, 3659,* det. Morton) and Brazil. Two additional specimens from Surinam are: petals lilac, stamens yellow, savanna forest, forest reserve Sectie O, *Lanjouw 157;* petals purple, anthers yellow, shrub, Voltzberg foot, savanna forest, *Lanjouw 923.*

SOLANUM SUBINERME Jacq. SURINAM: frequent, shrub to 2 m., Charlesburg Rift, 3 km. north of Paramaribo, *22728.* Trinidad, Guiana, Venezuela, Colombia, Brazil.

SOLANUM STRAMONIIFOLIUM Jacq. BRITISH GUIANA: frequent, suffrutescent plant to 2 m., flowers white, anthers yellow, fruit red, covered with stellate brown scurf, openings in mixed Mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22905.* Trinidad, Guiana, Venezuela, Brazil.

SOLANUM RUBIGINOSUM Vahl. SURINAM: subshrub to 2 m. high, flowers white, in low bush, one specimen seen in opening n.w. of Savanna VIII, Tafelberg, *24425;* shrub to 3 m., petals pink, anthers yellow, turning black, overhanging stream, lower North Ridge Creek, Tafelberg, *24806;* also collected in Surinam by Geyskes (no. *1018,* Coppenam River near Tonckensfalls, flowers pink with yellow anthers, leaves lustrous, dark green above, greyish pubescent beneath); and by Splitgerber (no. *1168,* in wood of the Pará district, flowers lilac [L]). The latter specimen has been cited by Pulle in his Enumeration of the Vascular Plants known from Surinam, p. 471, but no authentic material from French Guiana could be compared. The species, as here interpreted, is somewhat variable, particularly in the form of the calyx segment.

MARKEA PORPHYROBAPHES Sandw. BRITISH GUIANA: rare, vine from *Ilex* tree, grows to 8 cm. diameter, rope, leaves leathery, flowers greenish, fleshy, calyx green, corolla tube 5-ribbed, young fruits waxen-white, oblong, pointed, Kaieteur Plateau, *23174.* Only known from British Guiana.

MARKEA COCCINEA Rich. SURINAM: infrequent, vine, scandent and climbing, flowers orange, leaves thick, glossy, high mixed forest, south rocky slopes, Arrowhead Basin, Tafelberg, *24606;* rope, flowers bright orange, high forest, base south cliffs, Arrowhead Basin, *24471.* Guiana, Amazonian district.

CESTRUM LATIFOLIUM Lam. var. TENUIFLORUM (H.B.K.) O. E. Schulz. SURINAM: shrub to 4 m., Charlesburg Rift, 3 km. north of Paramaribo,

22752; infrequent, liana, flowers pink, climbing to 30 meters, *22775*. Venezuela, Colombia, Guiana, Brazil, the typical form also in the West Indies.

BRUNFELSIA GUIANENSIS Benth. SURINAM: frequent, slender shrub to 2 m., along bush trail to rear of village, Jacob kondre, *23894*. The specimen is sterile and the identification therefore somewhat tentative. French Guiana and Surinam.

LENTIBULARIACEAE[126]

Genlisea nigrocaulis Steyermark, sp. nov. Herba 4–10 cm. alta; foliis liguliformibus vel spatulato-oblongis, obtusis, laminis 6–7 mm. longis, 1.5–2.5 mm. latis; scapis glandulari-pilosis; squamis 1–6, basifixis, ovatis, acutis, 1–1.5 mm. longis; bracteis basifixis, ovatis, obtusis, 0.75–1 mm. longis, pilosis; pedicellis 7–13 mm. longis, glandulari-pilosis; bracteolis lateralibus 2, distinctis, lanceolatis, acuminatis, 0.75–1 mm. longis, 0.3 mm. latis, pilosis; lobis calycinis inaequalibus, ovatis vel lanceolatis, acutis, 1–1.4 mm. longis, 0.4–0.75 mm. latis, pilosis; corolla lutea, labio superiore late ovato, obtuso, 3–3.5 mm. longo, 2.5–3.75 mm. lato, labio inferiore 3-lobato, 3.5–4 mm. longo, 3.75–5 mm. lato, lobis late suborbicularibus, rotundatis; calcari horizontali conico-oblongo, obtuso, 4–5 mm. longo, labio inferiore longiore.

Herb 4–10 cm. tall; leaves in a dense rosette, ligulate or spatulate-oblong, obtuse, the blades 6–7 mm. long, 1.5–2.5 mm. wide, petioles 4–25 mm. long; scapes 1 or more, erect, mostly blackish, usually glandular-pilose, the hairs elongated and multicellular; scales 1–6, basifixed, ovate, acute, 1–1.5 mm. long; flowers 1–7, loosely racemose; pedicels ascending, 7–13 mm. long, glandular-pilose; bracts basifixed, ovate, obtuse, 0.75–1 mm. long, 0.75 mm. wide, pilosulous; bracteoles distinct, lanceolate, acuminate, 0.75–1 mm. long, 0.3 mm. wide, pilosulous; calyx lobes 5, unequal, ovate to lanceolate, acute, 1–1.4 mm. long, 0.4–0.75 mm. wide, pilosulous; corolla yellow; upper lip broadly ovate, obtuse, 3–3.5 mm. long, 2.5–3.75 mm. wide; lower lip 3-lobed, 3.5–4 mm. long, 3.75–5 mm. wide, the lobes broadly suborbicular, rounded; spur horizontally projecting, conic-oblong, obtuse, 4–5 mm. long, longer than the lower lip; capsule pilose, about 2.5 mm. in diameter.

TYPE: corolla butter yellow, stems blackish as are pedicels and calyx, in swamp on open level portion of plateau on southeast-facing slopes, Ptari-tepuí, state of Bolívar, Venezuela, alt. 1600 m., Nov. 1, 1944, *Julian A. Steyermark 59644*. Chicago Natural History Museum. Cotype: locally frequent, perennial herb to 16 cm. high, stem pubescent or glabrous, flowers pale yellow, savannas, Kaieteur Plateau, British Guiana, May 4, 1944, *Maguire & Fanshawe 23201*. Chicago Natural History Museum; New York Botanical Garden.

Genlisea nigrocaulis is related to *G. roraimensis* N. E. Brown, from which it differs in the longer pedicels, many-flowered inflorescence, longer spur and details of corolla and calyx, and more densely glandular and longer-haired scapes, pedicels, bracts, and calyx. From *G. anfractuosa* Tutin of British Guiana it differs in the pubescent calyx lobes, as well as other characters, and from *G. pulchella* Tutin, also from British Guiana, in the pubescent calyx and larger corolla.

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[126] By Julian A. Steyermark.

Although the type has densely glandular-pilose blackish scapes, pedicels, and calyx, the Maguire & Fanshawe collection has scapes varying from green to blackish and glabrous to glandular-pubescent.

UTRICULARIA AMETHYSTINA St.-Hil. & Gir. BRITISH GUIANA: locally occasional, to 20 cm. high, flowers purple, spur horizontal, lip with two white processes, wet sand on savannas, Kaieteur Plateau, *23290*. SURINAM: frequent, leaves broadly spatulate, bladders present, flowers purple, yellow protuberances in throat, shallow bogs, Savanna I, Tafelberg, *24197;* mossy banks of lower Augustus Creek, trail crossing, 0.5 km. above Falls, Tafelberg, *24727*. Venezuela and Trinidad to Brazil.

UTRICULARIA AMETHYSTINA f. **alutacea** (Tutin) Steyermark, comb. nov. *Utricularia alutacea* Tutin, Jour. Bot. **72**: 313–314. 1934. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23684;* infrequent, leaves spatulate, flowers white, bladders present, perhaps albino of *24197*, shallow bogs, Savanna I, Tafelberg, *24198*.

Although Tutin's fig. 4, p. 313 (Jour. Bot. **72**. 1934) shows the middle lobe of the lower corolla lobe prolonged and pointed, and is described as "longissimo acuto," this is not borne out by careful dissection of isotypic material (*Tutin 674* in U. S. National Herbarium). Although this middle part of the lower corolla is longer than the lateral lobes, it is obtuse and rounded. Other differences ascribed by Tutin to *U. alutacea* as distinct from *U. amethystina*, such as shape of leaf blade, sepal length, and glabrity of the corolla, are not borne out by examination of type material. Under magnification the spur and palate are found to be minutely puberulent. I can find no real differences separating these two species, which appear to agree in all respects except color. As a white-flowered form of *U. amethystina*, it seems at present logical to treat *U. alutacea* as such.

UTRICULARIA ANGUSTIFOLIA Benj. BRITISH GUIANA: occasional to locally frequent, perennial herb to 45 cm. high, leaves erect, flat, linear, flowers yellow, inflorescence branched, savannas, Kaieteur Plateau, *23205*. SURINAM: frequent, grass savanna, Zanderij II, *23685a.;* frequent, flowers white, grass savanna, Zanderij II, *23686;* common, leaves linear, flowers lavender, yellow protuberances, shallow bogs, Savanna I, Tafelberg, *24201*. Trinidad, Venezuelan Guyana, British Guiana, and Surinam.

UTRICULARIA HUMBOLDTII R. Schomb. BRITISH GUIANA: perennial aquatic herb growing in pools of water of *Brocchinia micrantha* leaves, leaves erect on long petioles, colorless bladders on subaerial leaves, leaves and flowers blue, savannas, Kaietur Platau, *23187*. Known only from British Guiana and the isolated table mountains of Venezuela, where it grows in water of the leaves of *Brocchinia Tatei*, the large bromeliad of that region. Although placed by Barnhart in *Orchyllium*, a study of the criteria by which he separates this and other genera from *Utricularia* does not appear to substantiate such segregation.

Utricularia kaieteurensis Steyermark, sp. nov. (fig. 24, A, B, C). **Herba annua 11–25 cm. alta; foliis 1–2, suborbicularibus, rotundatis, laminis 4–5 mm. longis, 4–8 mm. latis; scapis glabris; squamis ovato-lanceolatis, acuminatis, 0.75 mm. longis; bracteis 3, subaequalibus, ovato-lanceolatis, acutis, 1 mm. longis, lateralibus distinctis, angustioribus; pedicellis 6–7 mm. longis; calycis lobo superiore late ovato, subobtuso, 3 mm. longo, 2 mm. lato, glandulari-puberulenti; calycis lobo inferiore minore, suborbi-**

culari, paullo emarginato vel bilobato, 1.5 mm. longo, 1.5 mm. lato, glandulari-puberulenti; corolla alba, per omnes partes glandulari-pilosa, labio superiore late ovato, obtuso, subemarginato, 3.5 mm. longo, 2.5 mm. lato; labio inferiore suborbiculari, late 3-lobato, 4 mm. longo, 4 mm. lato; calcari descendente, 5 mm. longo.

Herb 11–25 cm. tall; leaves 1 or 2, radical, suborbicular, rounded, the blades 4–5 mm. long, 4–8 mm. wide; scape solitary, glabrous; scales 5–7, ovate-lanceolate, acuminate, 0.75 mm. long; inflorescence racemose, 1–3-flowered; pedicels 6–7 mm. long; bracts 3, subequal, ovate-lanceolate, acute, 1 mm. long, the lateral ones distinct, narrower than the middle bract; upper calyx lobe broadly ovate, subobtuse, 3 mm. long, 2 mm. wide, glandular-puberulent; lower calyx lobe smaller, suborbicular, shallowly emarginate or bilobate at apex, 1.5 mm. long, 1.5 mm. wide, glandular-puberulent; corolla white, glandular-puberulent throughout, upper lip broadly ovate, obtuse, subemarginate, 3.5 mm. long, 2.5 mm. wide; lower lip suborbicular, broadly 3-lobed, the lobes broadly rounded, about 4 mm. long and 4 mm. wide; spur descending, conic in lower half, narrow-cylindric in upper portion, 5 mm. long; ovary glandular-puberulent; capsule about 2.5 mm. long, glandular-puberulent.

TYPE: occasional to rare, perennial herb to 25 cm. high, stems delicate, rhizomes fragile, minute bladders, leaves 2–8 mm. broad, spatulate, flowers white, sedge bog on savanna, Kaieteur Plateau, British Guiana, May 4, 1944, *Maguire & Fanshawe 23204*. Chicago Natural History Museum; New York Botanical Garden.

This species differs from *U. hirtella* St.-Hil., a related Brazilian species, in its much larger corolla, glabrous stems and pedicels, and bracts divided to the base. It possesses, among other characters, a puberulent calyx and corolla, in these respects resembling a closely related species to be described from the Venezulan Guyana.

UTRICULARIA LONGECILIATA DC. BRITISH GUIANA: occasional to frequent, annual herb to 25 cm. high, basal rosette of leaves, flowers yellow, in damp sand, Kaieteur Plateau, *23114*. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23685*. Dutch and British Guiana, Venezuela, and Brazil.

Utricularia Maguirei Steyermark, sp. nov. (fig. 24, A, B). Herba 11–30 cm. alta; foliis obovatis vel spatulatis, rotundatis, 1–3 cm. longis, 0.7–1.5 cm. latis; scapis glabris; squamis lanceolatis, acuminatis, 2.5–3 mm. longis, glabris; bracteis lanceolatis, 2–2.5 mm. longis, 0.5 mm. latis; bracteolis brevioribus, triangulari-subulatis, 1.5 mm. longis, 0.3 mm. latis; pedicellis 3–3.5 mm. longis; calycis lobo superiore late ovato, abrupte acuminato, minute ciliolato, 4.25 mm. longo, 4 mm. lato; calycis lobo inferiore suborbiculari-ovato, apice bidentato, minute ciliolato, 4.25 mm. longo, 5 mm. lato; corolla lilacea, extus glandulari-puberula, labio superiore oblongo, obtuso, 5 mm. longo, 3.5 mm. lato; labio inferiore late obovato, apice rotundato, 6.5 mm. longo, 6.75 mm. lato; calcari 5.5–6.5 mm. longo.

Herb 11–30 cm. tall; leaves 3–4, rather thin, inconspicuously nerved, obovate to spatulate, rounded above, gradually decurrent on petiole, including the petiole 1–3 cm. long, 0.7–1.5 cm. wide; scape solitary, glabrous; scales 3–4, lanceolate, acuminate, 2.5–3 mm. long; raceme terminal, simple or branched, 3–11-flowered, the flowers rather remote, 1.5–2.5 cm. distant;

pedicels 3–3.5 mm. long, glabrous; middle bract lanceolate, 2–2.5 mm. long, 0.5 mm. wide; bracteoles shorter, triangular-subulate, 1.5 mm. long, 0.3 mm. wide; upper calyx lobe broadly ovate, abruptly acuminate, minutely ciliolate, 4.25 mm. long, 4 mm. wide; lower calyx lobe suborbicular-ovate, bidentate at apex, minutely ciliolate, 4.25 mm. long, 5 mm. wide; corolla lilac, glandular-puberulent without, upper lip oblong, obtuse, 5 mm. long, 3.5 mm. wide; lower lip broadly obovate, rounded at apex, 6.5 mm. long, 6.75 mm. wide; spur horizontal, equaling or slightly longer than lower lip, 5.5–6.5 mm. long.

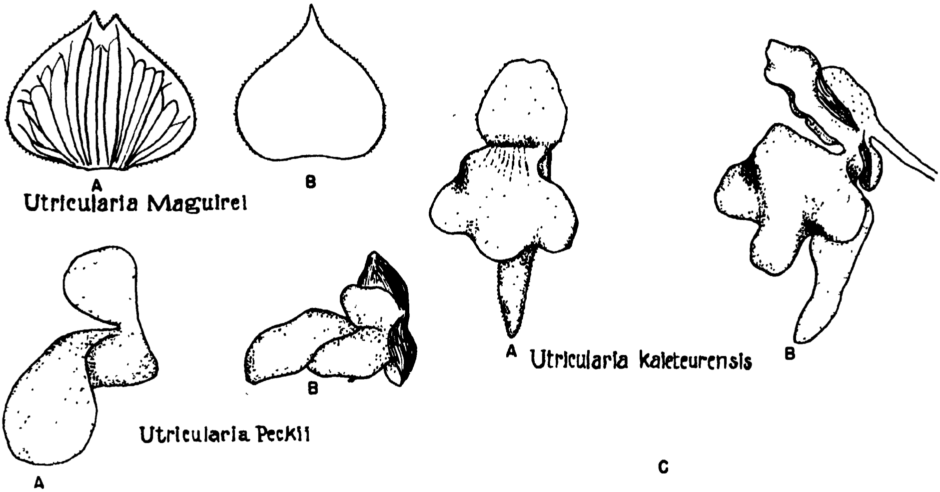

FIG. 24. *Utricularia kaieteurensis* Steyermark, sp. nov. (right). A. corolla, nearly anterior view (×11). B. corolla and calyx, lateral view (×12). C. lower calyx lobe (×10). *Utricularia Maguirei* Steyermark, sp. nov. (upper left). A. lower calyx lobe (×10). B, upper calyx lobe (×10). *Utricularia Peckii* Blake (lower left). A. corolla showing short bluntish spur (×10). B. corolla and calyx, with lower corolla lobe raised to show attachment of low broad spur (×9).

TYPE: locally common, to 30 cm. high, leaves spatulate, flowers lilac, wet sand on savannas, Kaieteur Plateau, British Guiana, May 5, 1944, *Maguire & Fanshawe 23249*. Chicago Natural History Museum; New York Botanical Garden.

This species belongs to that section of the genus characterized by such species as *U. longifolia* Gardn., *U. reniformis* St.-Hil., *U. nelumbifolia* Gardn., and *U. calycifida* Benj. It simulates *U. calycifida*, but that species is described as having a yellow corolla. Distinguished by its short spur, short lower corolla lip, suborbicular lower calyx lobe, and cuspidate upper calyx lobe, it is most closely related to a species to be described later from one of the table mountains in the Venezuelan Guyana.

UTRICULARIA PECKII Blake. *U. rubricaulis* Tutin. BRITISH GUIANA: locally frequent, perennial herb to 5 cm. high, flowers subsessile, yellow, wet sand on savannas, Kaieteur Plateau, *23200*. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23687*. British Honduras, Dutch and British Guiana.

An examination of type material of *Utricularia rubricaulis* Tutin (*Tutin 669*, in U. S. National Herbarium) reveals that it is conspecific with *U. Peckii* Blake, described from British Honduras. Although Tutin's description of the spur as "4.5–5.0 mm. longum, conicum acutum,"[127] accompanied by his fig. 5, would indicate that it was quite different from that described by Blake,[128] actually such is not the case. Careful dissection of isotypic material (*Tutin 669*) shows the spur to be a short, rounded, gibbose, blunt process only 1–1.5 mm. long and 2 mm. broad. It is certainly not acute and the measurement given by Tutin is erroneous. Blake correctly described the type of spur in *U. Peckii*, and this is the same as that found in Tutin's collection, as well as in carefully preserved material collected by Maguire and Fanshawe (*23200*) (fig. 24, A, B). Although Tutin[129] states that "Some time was devoted to examining the species of *Utricularia* in the field, and it was found that such characters as the direction of the spur and the colour of the flowers were very constant. . . . Consequently any tendency to 'lump' species described from Tropical America as a result of the examination of herbarium material alone is probably unjustified," it is not quite understandable how such an important character as the spur could be described as erroneously as in this case.

Other statements found in the description of *U. rubricaulis* and not borne out by examination of type material are the following: (1) the length of the sepals, stated to be 1.5 mm., was found to be 2 mm.; (2) the upper calyx lobe, described as acute, was found to be obtuse; (3) the upper corolla lobe, described as 2 mm. long, measured 2.5–3 mm. long; (4) the lower corolla lobe varied from 4–4.5 mm. long, although in the description it is stated to be 4 mm. long.

For the affinities with other species, Tutin compares his *U. rubricaulis* with *U. adpressa* St.-Hil., *U. Peckii* Blake, and *U. virgatula* Barnh. [= *U. juncea* f. *virgatula* (Barnh.) Fern.]. Of these, *U. Peckii* is the only one with which it can be compared closely, since the others mentioned all have a much longer spur and an acute to acuminate upper calyx lobe. The two species (*U. Peckii* and *U. rubricaulis*) are supposed to differ chiefly in size of flower and length of pedicels, but such differences are not found when careful examination is made of type material. With no other outstanding characteristics separating these species, and with the description of the spur of *U. rubricaulis* erroneous as shown by an examination of type material, I am uniting the two under the earlier name, *U. Peckii.*

UTRICULARIA PELTATA (Spruce) Oliver. BRITISH GUIANA: infrequent, 8–10 cm. high, flowers lilac with purple spot on lip, on shady stream bank, savanna, Kaieteur Plateau, *23240*. Known only from Brazil and British Guiana.

UTRICULARIA SUBULATA L. BRITISH GUIANA: abundant in marshy areas, savannas, Kaieteur Plateau, *23166*. SURINAM: common, fine linear leaves on delicate rhizomes, flowers yellow, shallow bogs, Savanna I, Tafelberg, *24200*. Widely distributed, in the United States from Mass. to Fla. and Tex., near the coast, south to Mexico, West Indies, Central America, and South America.

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127 Jour. Bot. 72: 312. 1934.

128 Contr. Gray Herb. 52: 90. 1917.

129 Jour. Bot. 72: 306. 1934.

UTRICULARIA SUBULATA f. CLEISTOGAMA (Gray) Fern. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23688*. Occurring within the range of the species. This small-flowered form, with usually shorter spurs and creamy or whitish corollas, may occur with the species or in separate stands. Various intermediate types are found between the smallest extremes and the large typical form of the species.

BIGNONIACEAE[130]

ARRABIDAEA CANDICANS (Rich.) DC. BRITISH GUIANA: liana, leaves glaucous below, flowers mauve, occasional to locally frequent, from *Aniba excelsa* in wallaba bush, Kaieteur Savanna, *23223*. SURINAM: leaves glaucous below, flowers lavender, buds velvety-purple, savanna vicinity Sectie O, *25020*. Tropical America, widely distributed from British Honduras and Costa Rica to Bolivia and Amazonian Brazil.

Arrabidaea Fanshawei Sandwith, sp. nov. Sect. *Microcarpaeae*. *A. Agno-casto* (Cham.) DC. affinis, foliolis fere concoloribus subtus haud griseo-tomentellis, calyce corollaque majoribus, corollae tubo antice curvato, staminibus longioribus scilicet anticis e corrola paullo exsertis, ovario laevi, ovulis pro loculo pluribus differt.

Frutex alte scandens, cirrhis ut videtur simplicibus; ramuli velut petioli, petioluli, inflorescentia ubique griseo-tomentelli, teretes, tenuiter costati, nodis inter petiolos consociebus glandularum praediti; pseudostipulae haud evolutae. *Folia* 2–3-foliolata; petioli 1–6 cm. longi; petioluli supra canaliculati, laterales 0.5–1.4 cm., terminales 2.0–2.5 cm. longi; foliola elliptica, ovato-elliptica vel obovato-elliptica, terminalia obovata, apice cuspidata, basi rotundata vel obtusa ac obliqua, 5–12 cm. longa, 2.5–7.0 cm. lata, firme chartacea vel tenuiter coriacea, fere concolora, supra oculo nudo glabra sed sub lente forti praesertim secus costam nervosque minute pubescentia, subtus secus costam nervosque copiose necnon tota pagina sparse pubescentia, haud punctulata, nervis primariis utrinsecus costae 5–7 his cum costa supra planis subtus promentibus, venulis intricatissime reticulatis subtus prominulis. *Inflorescentia* terminalis, ampla, speciosa, scilicet thyrsum pyramidalem circiter 15–25 cm. latum ubique griseo-tomentellum efformans; rami primarii inferiores ex axillis foliorum plane evolutorum orientes, ascendentes, ad 25 cm. longi, superiores sursum arcuati; ramuli secundarii breves, apice trichotomias cymarum congestarum gerentes; pedicelli 0.5–1.5 cm. longi. *Calyx* turbinato-campanulatus, ore integro vel brevissime denticulato, 3.5–4.5 mm. longus, 3.5–5.0 mm. latus, extra griseo-tomentellus, statu vivo violaceo-purpureus. *Corolla* parva, violaceo-purpurea, anguste infundibulari-hypocrateriformis; tubus subcylindricus, 1 cm. longus, dimidio inferiore rectus glaber 2 mm. diametro, superiore curvatus sensim paullo (ad 3.5 mm.) ampliatus extra furfuraceo-tomentellus, intus infra lobos labii inferioris pilosus; limbus conspicue bilabiatus, 1.0–1.5 cm. diametro, extra furfuraceo-tomentellus; labium superius ad $\frac{1}{3}$ tantum fissum, 5.0–7.5 mm. longum 5.0–6.5 mm. latum, intus infra lobos nisi prope margines glabrum; labium inferius fere ad basin fissum, lobis obovato-spathulatis 4.0–6.5 mm. longis 3–4 mm. latis intus papilloso-pubescentibus. *Stamina* prope medium tubi inserta; antica (longiora) 5.5–6.0 mm. longa thecis ex ore corollae

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exsertis, postica 3.5–4.0 mm. longa, quintum staminodiale anantherum 1.75 mm. longum, omnia basi dilatata atque conspicue lepidoto-papillosa; thecae antherarum divergentes, glabrae, 0.8–1.0 mm. longae, connectivo in apiculum minutum conicum producto. *Discus* pulvinatus, 0.4–0.6 mm. altus. *Ovarium* ellipsoideo-oblongum, subquadrangulare, 1.0–1.5 mm. longum, glabrum vel glabrescens; stylus glaber, 6 mm. longus, stigmatibus brevibus vix 0.5 mm. longis; ovula biseriata, in quaque serie 5–6. *Capsula* non visa.

TYPE: 10 cm. diam., medium-hard, grey-brown rope from crown of an Eschweilera in mixed forest, calyx and corolla violet-purple, Mazaruni Station, British Guiana, January 24, 1944, *Fanshawe* in *F.D. 4288*. Kew Herbarium; New York Botanical Garden. British Guiana: rope from crown of fallen Catostemma, young shoots gray-green, leaves thinly leathery, calyx pale purple, corolla purple, Takutu Creek to Puruni River, Mazaruni River, *Fanshawe* in *F.D. 4810*.

ARRABIDAEA INAEQUALIS (DC. ex Splitg.) K. Schum. SURINAM: liana climbing to 30 m., flowers pink, infrequent at Charlesburg Rift, secondary jungle, 3 km. north of Paramaribo, *22775*. Trinidad, Guiana, Amazonian Brazil and Venezuela.

ARRABIDAEA NIGRESCENS Sandwith, forma? SURINAM: rope, flowers dark purple, high mixed wallaba forest, vicinity of Camp No. 2, km. 7, Saramacca River Headwaters, *24877*. British Guiana, Amazonian Brazil. If correctly interpreted, the first record for Surinam.

The material is poor and is referred to this species with some doubt, as a form with the indumentum of the leaflets composed of very minute branched hairs, and the inflorescence with shorter branches and therefore narrower in aspect. A recent collection of *A. nigrescens* in British Guiana, *F1508* (*F.D. 4244*), 107 miles Bartica-Potaro Road, Nov. 16, 1943, bears fruit, which may now be described for the first time: capsule elongate-linear, narrowed to an obtuse apex and base, 40–43 cm. long, 2.5 cm. broad, glabrous, impressed-lepidote, the valves rigid and woody, with a rather thin and barely prominent median rib. Seeds large, up to 2 cm. long and 7 cm. or more broad, glabrous, the embryo pale brown, the wings papery-membranous, scarcely or slightly hyaline, string-colored. The capsule, therefore, as would have been expected, closely resembles that of *A. mollis* (Vahl.) Bur. et K. Schum. *A nigrescens* appears to be variable in the quantity and size of the hairs composing the indumentum of the leaflets; it may eventually prove to be only a variety of a polymorphic species *A. mollis*.

PARAGONIA PYRAMIDATA (Rich.) Bur. BRITISH GUIANA: liana, flowers mauve pink, occasional on riverside, Potaro River above Kaieteur Fall, *23366;* Waiapi Creek, lower Mazaruni River, *F1409* (*F.D. 4145*). SURINAM: rope, flowers deep pink, Toekoemoetoe Creek, Saramacca River, *24918;* flowers pink, vicinity Sectie O, km. 68, *25001*. Widely distributed on Continental Tropical America, Trinidad, Tobago and Guadeloupe.

POTAMOGANOS MICROCALYX (G.F.W. Mey.) Sandw. BRITISH GUIANA: black rope 2 cm. diam., leaves paired, stalked on common petiole, flowers in axillary inflorescences, paired on inflorescence, glabrous, corolla tubular, magenta-purple, Mazaruni Station, *F1267* (*F.D. 4003*); Madray-Bubu trail Essequibo-Demerara, *F1684* (*F.D. 4420*). British Guiana and Surinam.

ROENTGENIA SORDIDA (Bur. & K. Schum.) Sprague & Sandwith. BRITISH GUIANA: rope 4 cm. diam., flowers in terminal inflorescences, tubular, Takutu Creek to Puruni River, Mazaruni River, *F2117* (*F.D. 4853*). Guiana, Amazonian Brazil.

CYDISTA AEQUINOCTIALIS (L) Miers. SURINAM: vine, flowers lavender, deeply striped within throat, frequent along river near Brokolonka, Saramacca River, *23797;* liana, corolla lobes deep lavender, throat lined purple, tube white, frequent on Tawa Creek, Saramacca River, *24076;* liana, corolla white, mixed high forest at base of west escarpment, Tafelberg, *24700.* Tropical America; variable and widely distributed, from Central America to the West Indies, Colombia, Venezuela, and Amazonian Brazil and Peru.

ANEMOPAEGMA PARAËNSE Bur. & K. Schum. BRITISH GUIANA: rope 5–10 mm. diam., flowers constricted above calyx, fascicled, axillary or lateral, calyx tubular, Barima River opposite Anabisi Creek *F2464* (*F.D. 5200*). Trinidad, Guiana, Amazonian Brazil and Peru.

Anemopaegma Maguirei Sandwith, sp. nov. *A. citrino* Mart. ex DC. ex descriptione ut videtur affinis, habitu, petiolis petiolulisque brevioribus, indumento diverso magis evoluto, foliolis opacis basi cordatulis differt; ab *A. umbellato* A. Samp. habitu, indumento et praecipue forma foliolurum statim distinguitur.

Frutex scandens; ramuli subteretes, costato-striati, costis senectute longitudinaliter rimoso-fissis, dense satis minute pilosulo-pubescentes; pseudostipulae haud evolutae. *Folia* 2–3-foliolata, 2-foliolata nonnunquam cirrho apice uncinato-trifurcato terminata; petioli 2–3 cm. longi, velut petioluli pilosulo-pubescentes; petioluli laterales breves, 2–4 mm. tantum longi, petiolulus terminalis ad 9 mm. longus; foliola elliptica vel ovato-elliptica, apice breviter vel brevissime late acuminata, basi rotundata atque distincte cordatula, 7–9 cm. longa, 2.8–4.3 cm. lata, summa minora, coriacea marginibus revolutis, siccitate supra olivacea opaca subtus pallide viridia, secus costam utrinque praesertim supra pubescentia, ceterum glabra nisi secus margines prope basin, utrinque (subtus crebrius) punctato-lepidota, subtus etiam dense minutius lepidota, praeterea subtus basi utroque costae latere glandulis patelliformibus foveolis insidentibus praedita, costa supra canaliculato-impressa subtus velut nervis primariis valde promenente, his utroque costae latere 6–7 arcuato-ascendentibus ac anastomosantibus, rete venularum utrinque prominulo. *Inflorescentia* axillaris, thyrsum brevem racemiformem pauciflorum vix 2 cm. longum ubique pilosulo-puberulum efformans; bracteae obscurae, filiformi-oblongae, circiter 1 mm. longae; pedicelli circiter 5 mm. longi. *Calyx* cupulato-campanulatus, satis brevis, 4–6 mm. longus, ad 8 mm. latus, extra pilosulo-pubescens atque dimidio superiore consociebus glandularum praeditus, margine sinuato ciliolato haud denticulato. *Corolla* campanulato-infundibularis, subrecta vel parum curvata,. membranacea, lobis inclusis ad 6.5 cm. longa; tubus pallide flavus, parte basali cylindrica circiter 1.4 cm. longa 7 mm. lata, extra dense minute lepidotus, intus satis sparse punctato-lepidotus praeterea circa insertionem staminum zona pilorum hyalinorum papilliformium praeditus; limbus cremeo-albus, 3 cm. diametro, lobis ciliolatis utrinque punctato-lepidotis extra prope medium glandulis patelliformibus sparsis instructis. *Stamina* circiter 1.3 cm. supra tubi basin inserta, longiora (antica) 2.5 cm. breviora 2.1 cm. longa; staminodium 6 mm. longum; antherarum thecae divergentes, 4 mm.

longae. *Discus* pulvinatus, 1.5 mm. altus. *Ovarium* ellipsoideum, basi supra discum contractum, 3 mm. longum, 2 mm. latum, minutissime lepidotum; stylus glaber, 4 cm. longus; ovula pro loculo quadriseriata, in quaque serie 4–5. Capsula ignota.

TYPE: vine, corolla tube pale yellow, lobes cream-white, in high bush northeast of Savanna I, Tafelberg, Surinam, August 17, 1944, *Maguire 24403*. Kew Herbarium; New York Botanical Garden.

This plant is quite unmatched in the Kew material and is noteworthy for the indumentum of the vegetative parts and calyces, the absence of developed pseudostipules, the unusually short petiolules, the small opaque coriaceous leaflets which are distinctly though very slightly cordate at the base, the very short lateral inflorescences and the short calyces. The nearest relative, perhaps very closely allied, is apparently *A. citrinum* Mart. ex DC., of which no specimen has been available for examination. From the evidence of Schumann's description in the Flora Brasiliensis, *A. citrinum* produces branchlets with an erect fruiticose habit (although tendril-bearing leaves are also present), the petiolules (and the petioles of lower leaves) are longer than those of Dr. Maguire's plant, and their indumentum is composed of curved ferrugineous-puberulous hairs, evidently differing from that of *Maguire 24403* which consists of stiff, mostly straight, whitish-hyaline hairs. *A. citrinum* is further described as having the leaflets shining above and truncate or obtuse at the base, the calyx merely lepidote (not pubescent), and a shorter, curved corolla. It has been once collected, by Prince Wied-Neuwied in the state of Bahia, Brazil. *A. velutinum* Mart. ex DC. still further differs on account of the dense conspicuous indumentum on all the vegetative parts; while *A. umbellatum* A. Samp., which has very short petiolules, is glabrous and has remarkable long and narrowly elliptic-lanceolate leaflets.

CLYTOSTOMA BINATUM (Thunb.) Sandwith. SURINAM: rope, flowers lavender, white within throat, overhanging Toekoemoetoe Creek, Saramacca River, *24913*. Tropical South America, Venezuela, Guiana, Brazil and Paraguay.

MARTINELLA OBOVATA (H.B.K.) Bur. & K. Schum. BRITISH GUIANA: liana, occasional on riverside, Potaro River above Kaieteur Falls, *23360*. Widely distributed in Continental Tropical America, also in St. Vincent, Tobago and Trinidad.

DISTICTELLA RACEMOSA (Bur. & K. Schum.) Urb. BRITISH GUIANA: liana, fruit flat convex greenish with sunken warts, frequent on riverside, Potaro River above Kaieteur Falls, *23358;* Kauria Creek, lower Cuyuni River, *F1424* (*F.D. 4160*); Groete Creek, Essequibo River, *F1760* (*F.D. 4496*). Guiana, Amazonian Brazil, Colombia, Tobago.

STIZOPHYLLUM sp. BRITISH GUIANA: rope, leaves trifoliate, fruit long, flat, black. Takutu Creek to Puruni River, Mazaruni River, *F2067* (*F.D. 4803*).

MEMORA FLAVIFLORA (Miq.) Pulle. BRITISH GUIANA: vine, black, wiry stems, branching at right angles, flowers stalked, axillary, tubular, yellow. Mazaruni Station, *F795* (*F.D. 3531*). Guiana.

MEMORA SCHOMBURGKII (DC.) Miers. BRITISH GUIANA: Groete Creek, Essequibo River, *F1719* (*F.D. 4455*). SURINAM: vine, flowers white, frequent in bush to rear of village, Jacob kondre, Saramacca River, *23862;*

vine, flowers yellow, overhanging Tafelberg Creek, Saramacca River, *24908*. Widely distributed in northern South America.

PACHYPTERA KERERE (Aubl. emend. Splitg.) Sandwith. BRITISH GUIANA: rope, 1 cm. diam., stems squarish, glandfields at nodes, pseudo-stipules, flowers in drooping inflorescences, flowers milk white, stamens woolly, Mazaruni Station, *F1419* (*F.D. 4155*). Central America, Colombia, Venezuela, Guiana and Amazonian Brazil.

CALLICHLAMYS LATIFOLIA (Rich.) K. Schum., forma. BRITISH GUIANA: rope 5 cm. diam., flowers in axillary thyrses, buds oblong-globose, corolla yellow, fruit elliptical, flattened, green, seeds brown, flat, rounded with membranous wing, Baramanni Creek, Waini River, N.W.D., *F2339* (*F.D. 5075*). Bartica-Potaro Road, *F1503* (*F.D. 4239*). Panama, Colombia, Venezuela, Trinidad, Guiana, Brazil, Bolivia.

MADFADYENA UNCATA (Andr.) Sprague & Sandwith. BRITISH GUIANA: vine flowers yellow, fruit dark brown, claw-like tendril sometimes replaces terminal leaflet, Mazaruni Station, *F2198* (*F.D. 4934*). Mexico, Venezuela, Trinidad, Guiana, Amazonian Brazil, Bolivia.

TABEBUIA INSIGNIS (Miq.) Sandwith var. MONOPHYLLA Sandwith (*T. longipes* Baker). BRITISH GUIANA: small tree to 4 m., 4 cm. diam., simply branched, leaves thickly leathery, flowers fascicled in forks of stem, white, locally frequent on Kaieteur Savannah, *23262;* Mazaruni Station, *F528* (*F.D. 3264*). Surinam, British Guiana.

TABEBUIA CAPITATA (Bur. & K. Schum.) Sandwith. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F1283* (*F.D. 4019*); small, weakly branched tree, yellow flowers, frequent on Savanna III, Tafelberg, *24401*. Guiana, Amazonian Brazil.

TABEBUIA SERRATIFOLIA (Vahl) Nichols. BRITISH GUIANA: seedlings from below parent tree which was in flower at the time, Groete Creek, lower Essequibo River, *F1242* (*F.D. 3978*).

TABEBUIA SUBTILIS Sprague & Sandwith. BRITISH GUIANA: tree 5 m., 8 cm. diam., usually flowering without leaves, flowers bright yellow, pendent, crinkled, fruit brown-green, cylindrical, pendent, below Tukeit, Potaro River Gorge, *23493*. At present known only from the rocky banks of rivers in British Guiana.

TABEBUIA STENOCALYX Sprague & Stapf. BRITISH GUIANA: tree 80 ft. high, 12 in. diam., buttressed to 6 ft., adventitious shoots from base of trunk, flowers stalked terminally, bracteose, fruit cylindrical, seeds green with white membranous lining, Groete Creek, lower Essequibo River, *F1260* (*F.D. 3996*)., Groete Creek, Essequibo River, *F1743* (*F.D. 4479*).

TABEBUIA IPE (Mart.) Standl. var. INTEGRA (Sprague) Sandwith. SURINAM: mixed high forest, near north escarpment, Savanna I to foot of Augustus Falls, Tafelberg, *24751*. Brazil, Paraguay, northern Argentina. The first record from Surinam.

TABEBUIA sp. SURINAM: shrub to 2 m. high, flowers white, frequent on Savanna VIII, Tafelberg, *24639*.

The material is insufficient for specific determination or description, but suggests a form of *T. roraimae* Oliv. with young and relatively thin leaflets. *T. roraimae* has been known previously only from the Pacaraima Range.

JACARANDA RHOMBIFOLIA G.F.W. Mey. SURINAM: tree, flowers pale pur-

ple, frequent overhanging river between Pakka Pakka and Kwatta hede, Saramacca River, *24950*. Northern South America, Venezuela to Guiana.

SCHLEGELIA SPRUCEANA K. Schum. BRITISH GUIANA: rope 1 cm. diam.; flowers cauliflorous, crimson, young fruit oblong-globose, Takutu Creek to Puruni River, Mazaruni River, ***F2096*** (***F.D.*** *4832*).

PHRYGANOCYDIA CORYMBOSA (Vent.) Bur. & K. Schum. BRITISH GUIANA: rope, calyx white, corolla mauve-pink, 2-lipped, Mazaruni Station, ***F1188*** (***F.D.*** *3924*).

PSEUDOPAEGMA OLIGONEURON Sprague & Sandwith. BRITISH GUIANA: rope 2 cm. diam., flowers stalked, clustered in axils, corolla yellow, Mazaruni Station, ***F1263*** (***F.D.*** *3999*).

ACANTHACEAE[131]

In the following list the genera and species are dealt with in the same sequence as in my revision of the Acanthaceae in Pulle's *Flora of Suriname* (**4**: 166–254. 1938). The numbers in brackets refer to the pages of the latter where the descriptions are to be found.

MENDONCIA ASPERA Ruiz & Pav. (175). SURINAM: vine, bracts green, fruit very dark red, along railroad near km. 70, *23611;* bush to rear of Pakka Pakka, Saramacca River, *23971*.

APHELANDRA PARAENSIS Lindau (190). SURINAM: flowers scarlet, jungle to rear of Posoegronoe, *24029*. The collector describes this plant as a small shrub, but it is in reality a herb with a single unbranched stem, decumbent and rooting at the base.

APHELANDRA PECTINATA Willd. ex Nees (193). BRITISH GUIANA: frequent, large shrub with spikes encased in sheathing pink-brown, ciliate bracts, the spikes looking like candles on the shrub when in bud, calyx more or less pink, corolla scarlet with white hairs, Essequibo River, Keriti Creek, on loam along the creek, ***F875*** (***F.D.*** *3611*). SURINAM: Charlesburg Rift, 3 km. north of Paramaribo, on former sea beach consisting of deep sands underlain by shells, the sands covered by shrub and bordered by swamps and primary jungle, *22727;* Saramacca River, Jacob Kondre, in swampy bush along the trail, *23873*.

TRICHANTHERA GIGANTEA (Humb. et Bonpl.) Steud. (196). BRITISH GUIANA: soft-wooded tree of irregular growth, flowers scented like elder, calyx grey-green, pubescent, corolla tube in the lower half crimson and shiny, in the upper half like the reverse of the limb orange and pubescent, the upper side of the limb and the throat crimson and shiny, style nearly white, ovary yellow, Mazaruni Forest Station, ***F624*** (***F.D.*** *3360*).

HYGROPHILIA SANDWITHII Brem. Kew Bull. **1939**: 559. 1940. BRITISH GUIANA: procumbent herb with pink flowers, Mazaruni Station, local on sandy fore-shore, *23564*. Differs from *H. guyanensis* Nees (209) by the small number of flowers, usually but one, in the axillary cymes.

HYGROPHILIA ERECTA (Burm. f.) Hochr. *H. quadrvalvis* Nees. SURINAM: frequent in the swamps east of the Agricultural Experiment Station, Paramaribo, *22710*. This is an east-Asiatic species, and as it has never before been collected in Surinam, it is probably a recent introduction.

Polylychnis essequibensis Brem. sp. nov. Habitu scandente, ramis teretibus, panicula multo breviore, calycis lobis subulatis, granulis pollinis

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majoribus et alveolis pariete multo humiliore instructis ornatis, disco haud unilateraliter producto a *P. fulgenti* Brem. recedens; typus: *Maguire & Fanshawe 22944* in herbario trajectino.

Frutex scandens, glaber. Rami internodiis primum quadrisulcatis, mox teretibus, sicc. negrescentes. Folia petiolo canaliculato 3–12 mm. longo instructa; lamina subcoriacea, ovato-oblonga, foliorum minorum interdum elliptica, 5–11 cm. longa et 1.7–4.5 cm. lata, apice acuta vel longius acuminata, basi contracta, margine subintegra, utroque latere costae nervis 5–9 utrinque prominulis, venulis paucis subtus prominulis. Panicula pedunculo 1.5–2.5 cm. longo subglabro elata, axi pedunculo subaequilonga; ramuli infimi circ. 1 cm. longi, semel vel bis dichasialiter ramificati. Ramuli infimi interdum foliis magnitudine valde redactis suffulti, alii bracteis subulatis 1.5–2.0 mm. longis, pubescentibus. Bracteae ultimae vix 0.5 mm. longae, ceterum aliis similiores. Pedicelli 2 mm. longi, sicc. cystolithis parvis albidopunctati. Calyx subglaber tubo 2.5 mm. diam. et 1.5 mm. alto, lobis subulatis 5–6 mm. longis, margine vix conspicue ciliolatis. Corolla rubra 5–6 cm. longa, tubo incurvato ad basin 2 mm., dimidio superiore 10 mm. diam., faucem versus paulo contracto, basin versus puberulo, labiis 10 mm. longis, superiore in lobulos 5 mm. longos fisso, basi calcarato, inferiore usque ad basin in lobos tres aequaliter diviso. Stamina 11 mm. infra divisuras corollae inserta; filamenta vix conspicue puberula basi in membranam 2.5 mm. altam connata, partibus liberis 11.5 et 13 mm. longis; antherae 3 mm. longae. Granula pollinis 83 μ diam., intra membranam 78 μ, alveolis 12 μ diam., bene distinguendis. Discus integer, 0.7 mm. altus, glaber. Ovarium quoque loculo ovulis 3–4, 5 mm. altum, glabrum. Stylus vix conspicue puberulus, corollae subaequilongus. Lobus stigmaticus anticus 2 mm., posticus 0.6 mm. longus. Capsula nondum visa.

Habitat Guianam Anglicam.

TYPE: mixed forest, rare, Groete Creek, Kamuni Creek, Essequibo River, 21 April, 1944, *Maguire & Fanshawe 22944.* British Guiana: 12 March 1944, Mazaruni Forest Station, *F1761* (*F.D. 4497*).

The short conical spur at the base of the upper lip gives the unopened flower a truncate shape, the upper end of the truncate top being formed by the spur. The disk lacks the tooth which gives that of *P. fulgens* its peculiar shape, and the alveoles of the pollen grains are separated from each other by much lower walls. The generic description is to be revised on these points.

In the description of the genus *Polylychnis* (Rec. Trav. Bot. Néerl. **35**: 160. 1938) the latter was compared with *Lychniothyrsus* Lindau (Notizbl. Bot. Gart. Berlin-Dahlem **6**: 192. 1914) and with *Stemonacanthus* Nees (Fl. Bras. **9**: 53. 1847). By the courtesty of the Director of the Royal Botanic Gardens, Kew, I have had since then an opportunity to study an example of Lindau's type. It proved to be a plant with small sessile flowers, very similar to *Ruellia ochroleuca* Nees, l.c. 56, *pl. 5,* and to the other American *Ruellia* species recognized by Nees, viz. *R. tetragona* Link, *R. alba* Nees, and *R. hygrophila* Nees. All these plants are provided with a glandular-hirsute indumentum, more or less distinctly crenate leaves and a slightly zygomorphic corolla. As they can not be left in *Ruellia L.*, which, as I have argued elsewhere, is to be confined to the species provided with axillary cymes of large violet flowers with a campanulate corolla tube and a spread-

ing limb, i.e. to *R. tuberosa* L. and its nearest allies, Nees' American *Ruellia* species will have to be transferred to *Lychniothyrsus*, and become therefore: **Lychniothyrsus ochroleucus** (Nees) Brem., comb. nov. (*Ruellia ochroleuca* Mart. ex Nees, Fl. Bras. **9**: 56. 1847); **Lychniothyrsus tetragonus** (Link) Brem., comb. nov. (*Ruellia tetragona* Link, Enum. Hort. Berol. **2**: 133. 1822); **Lychniothyrsus albus** (Nees) Brem., comb. nov. (*Ruellia alba* Nees, Fl. Bras. **9**: 55, 1847); and **Lychniothyrsus hygrophilus** (Nees) Brem., comb. nov. (*Ruellia hygrophila* Mart. Flora **24**: Beibl. 2: 65. 1841).

ODONTONEMA SCHOMBURGKIANUM (Nees) Kuntze, Rev. Gen. 494. 1891. *Thyrsacanthus Schomburgkianus* Nees, London Jour. Bot. **4**: 636. 1845; DC. Prodr. **11**: 325. 1847. Herb with decumbent shoots and scarlet flowers. Potaro River, Tukeit; on the white sand of clearings at the forest edge, locally frequent, *23044*.

This specimen has the large and thin leaves of *O. macrophyllum* Gleason (Contr. N. Y. Bot. Gard. **282**: 300. 1926) which was collected in the same area, but the shortly pubescent inflorescence and the shorter calyx lobes of Nees' species, to which it is here provisionally referred.

DREJERA BOLIVIENSIS Nees. A specimen collected at an altitude of 200 m. in dense forest at the western end of the Kanuki Mountains in the drainage of the Takuto River (*Smith 3165*) was described by Leonard (Lloydia **2**: 213. 1939) as a new species under the name *Anisacanthus secundus*. The author compares this plant with *Anisacanthus Malmei* Lindau. Of the latter no material was available to me, but it would be worth while to reinvestigate this species, for it is quite possible that this too may prove to belong to Drejera.

Rhacodiscus calycinus (Nees) Brem., comb. nov. *Beloperone? calycina* Nees, London Jour. Bot. **4**: 637. 1845; DC. Prodr. **11**: 423. 1847. *Justicia acuminatissima* (Miq.) Brem. (239). BRITISH GUIANA: shoots and pedicels bronze-green, calyx bright green, corolla scarlet; Yarikita portage, N.W.D. along the trail on brown sand, *F2142, F.D. 5178;* Essequibo River, Groete Creek, Kamuni Creek, open spaces in mixed forest, *22919;* Saramacca River, vicinity of Tawa Creek, frequent, forming low bushes bordered by *Montrichardia arborescens 23740;* Tafelberg in high forest at the base of the southern cliffs at Arrowhead Basin, rare, *24480*.

When I dealt with this species in Pulle's *Flora of Suriname* Nees' *Beloperone? calycina* was not yet known to me. The Kew botanists, however, had at that time already recognized that the latter and *Justicia acuminatissima* must be regarded either as identical or at least as very nearly related. Material from British Guiana placed at my disposition by the intermediary of Mr. N. Y. Sandwith allowed me to establish the identity of the two species. That it is here once more referred to Lindau's genus *Rhacodiscus* finds its explanation in the following considerations. The generic name *Justicia* is, as I have pointed out in a paper that is awaiting publication, to be confined either to *J. hyssopifolia* L. alone or to the latter and a group of South African species of which *J. orchioides* L. f. is perhaps the best known representative, and the very numerous remaining species are therefore to be transferred to other genera. The American species with long-tubed red flowers are to be placed partly in *Beloperone* Nees and partly in *Rhacodiscus* Lindau, which differ from each other in the shape of the lower corolla lip and in that of the seeds. In *Beloperone* the lower corolla lip is

slightly wider than the upper one and 3-fid, and the seeds are distinctly swollen, whereas in *Rhacodiscus* the lower corolla lip is much narrower and only shortly 3-lobed and the seeds are flattened. To the character on which the genus was founded, the echinulate pollen grains, I attach no value, for the resemblance between *Rhacodiscus calycinus*, in which the pollen grains are of this type, and *Rhacodiscus secundus* (Vahl) Brem. with pollen grains of the same kind as those of *Beloperone* is so striking that it would be artificial to refer them to different genera.

Rhacodiscus secundus (Vahl) Brem., comb. nov. *Justicia secunda* Vahl, Symb. Bot. **2**: 7. 1791. BRITISH GUIANA: nodes with a red band, corolla and style red, Mazaruni River, Barakara Creek, on sandy soil along the river bank, *C.A.P.6*, (*F.D. 5259*).

In Pulle's *Flora of Suriname* besides *Justicia acuminatissima* five species were dealt with under this genus. Of these no. 2, the violet-flowered *J. carthaginensis* Jacq. was in the paper to which I referred above placed in an as yet unnamed genus in the neighborhood of *Beloperone*, no. 3 and 4, *J. pectoralis* Jacq. and *J. martiana* (Nees) Lindau in a new genus *Psacadocalymma*, and no. 6, *J. obtusifolia* (Nees) Lindau in *Dianthera* L., a name that is to be restricted to a group of exclusively American marsh plants with narrow leaves, axillary spikes and thin, smooth seeds with a dentate margin. The exact position of no. 5, *J. cayennensis* (Nees) Lindau (247) was not yet determined. The circumstance that this species is represented in the collection of the New York Botanical Garden Tropical Expedition of 1944 offers a welcome opportunity to discuss its affinities.

J. cayennensis was originally described by Nees (London Jour. Bot. **4**: 637. 1845) as a species of his genus *Amphiscopia*, but two years later in his monograph of the family (DC. Prodr. **11**: 346. 1847.) Nees transferred it to *Rhytiglossa*. The name *Rhytiglossa*, however, is to be restricted to a number of African species provided with lenticular, finely echinulate pollen grains, and for *Rh. cayennensis* with its flattened, doleiform pollen grains therefore a position is to be found elsewhere. In the terminal position of the inflorescence with its comparatively small flowers, and in the small size of the posticous calyx lobe it shows a rather striking resemblance to the species of the paleotropic genus *Rostellularia* Reichenb. It differs, however, from the latter in the shape and size of the cystoliths, which are not boomerang-shaped but nearly straight and much smaller, in the much wider connective, the ecalcarate thecae, the shape of the lumen of the pollen grains, which in *Rostellularia* reminds one of a sandglass, the entirely hirtellous, not merely comose ovary, and in the distinctly unguiculate capsule. These differences are of sufficient importance to justify the creation of a new genus. On account of the weakly developed fifth calyx lobe I propose for this genus the name *Dyspemptemorion*. So far it is monotypic.

Dyspemptemorion Brem., gen. nov. *Justicearum* neo-tropicarum granulis pollinis doleiformibus parvis, utroque latere pororum serie singula tuberculorum ornatis, inflorescentiis spiciformibus terminalibus, bracteis penninerviis imbricatis, calycis lobo postico magnitudine multo redacto ad *Rostellulariam* Reichenb. accendens, lumine granulorum pollinis ad medium haud distincte constricto, cystolithis haud conspicue curvatis, connectivo lato, thecis utrisque ecalcaratis, ovario toto hirtello, capsula distincte unguiculata ab ea recedens.

Herba gracilis. Folia breviter petiolata, opposita aequalia, cystolithis subrectis parvis sparsa. Inflorescentiae spiciformes, terminales, interdum spicis una vel duabus ex axillis foliorum supremorum orientibus comitatae, floribus inferioribus interdum superpositis. Bracteae decussatae, primum imbricatae, ovato-lanceolatae, basi in petiolum brevem contractae, penninerviae, ciliatae. Bracteolae bracteis atque calyci subaequilongae, angustae, 1-nerviae, ciliatae. Calyx inaequaliter 5-partitus; lobi angusti, ciliati, posticus aliis multo minor. Corolla dilute violacea vel albida, calyce bis vel triplo longior; labia tubo paulo breviora, superius triangulare, rugula instructum, inferius breviter 3-lobatum, palato e bullis duabus parallelis formato, striis notato instructum. Stamina 2; filamenta glabra; antherae connective lato instructae; thecae subglobosae, sese dimidio obtegentes, ecalcaratae. Granula pollinis doleiformia, paulum complanata, parva (25–32 μ longa), 2-pora, utroque latere pororum serie singula carunculorum ornata, lumine ad medium haud distincte constricto. Discus annularis. Ovarium totum hirtellum. Stylus basi sparse hirtellus. Stigma parvum, indivisum. Capsula unguiculata, hirtella, valvulis 2-seminalibus. Semina superposita, complanata, brunnea, muricata.

Distr. in America tropicali.

TYPUS generis: *Dyspemptemorion cayennense* (Nees) Brem. (*Amphiscopia* et *Rhytiglossa cayennensis* Nees).

Dyspemptemorion cayennense (Nees) Brem., comb. nov. *Rhytiglossa cayennensis* Nees, DC. Prodr. **11**: 346. 1847. SURINAM: frequent, annual herb, flowers white, swampy bush above the village of Jacob kondre, along the Saramacca trail, *23882*, June 18, 1944.

(*23883* consists partly of this species and partly of *Psychotria officinalis* (Aubl.) Rausch. The note on the label "peduncles and bracts blue; fruit lighter blue, pedicels reflexed" evidently refers to the latter.)

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TORREYA

REVIEWS

The Cultivated Species of Primula. By Walter C. Blasdale. University of California Press, Berkeley, California. 1948.

Dr. Blasdale has given us a book from which we may learn far more than the taxonomy of the genus *Primula*. It is unique in dealing so thoroughly with the plant, botanically and horticulturally. The introductory chapters discuss the history and methods of classification of the numerous sections of the genus. Biological characteristics are explained and we are taught much of interest and importance as to the possibilities of viable seeds from hybrids, methods of increasing farination, and other features of value.

Then on to horticultural requirements and methods which many readers will study closely. ''A fair percentage are no more difficult to grow than pansies'' is a welcome statement, since so many gardeners look upon all primulas with the exception of *P. polyantha* and the greenhouse species as well-nigh impossible. ''Emphasis should be placed upon the composition of the solution derived from the action of water on the mineralogical components of the soil, rather than the soil itself'' explodes the pH theory so important to some scientists. Dr. Blasdale lays much more emphasis on good drainage and says that erring on the side of too much sand rather than too much clay is a safe rule, because primulas have two biological peculiarities—first, rapid transpiration, and second, since frequent applications of water are unavoidable, the importance of free circulation through the soil medium. Shade requirements are discussed and the use of a lath house may explain something of the success of the writer.

From the chapter on growing we move to a monograph of the genus, discussed by treating each section separately, beginning with the primroses and cowslips and ending with the less known; in all between 400 and 500 species. There are a few errors in nomenclature and one or two species are doubtfully placed in their correct section.

In the final chapter gardeners are mildly reprimanded for the limited variety grown in the United States and indeed for the lack of variety of ornamental plants generally.

The book is well illustrated with pages given over to two or more half tones.

This is a book of real value to gardeners everywhere as well as to students of botanical subjects.—JAMES G. ESSON.

Drawings of British Plants. By Stella Ross-Craig. Part I. Ranunculaceae. *pl. 1–44.* Part II. Berberidaceae, Nymphaeaceae, Papaveraceae, Fumariaceae. *pl. 1–22.* London: G. Bell & Sons Ltd. 1948.

These two parts are the first of what is planned to be a work of some importance, its object being to illustrate the species of flowering plants native in the British Isles in 1500–1800 drawings. Each part, dealing with one or more families, is to be complete in itself, bound in heavy paper with a decorative design. In the parts now before us, each species is illustrated by a whole page, bearing from 6 to 14 figures. In addition to a general sketch of the species, there are abundant diagnostic details, with magnifications indicated. It is not intended to illustrate varieties or micro-species.

Miss Ross-Craig is the artist at the Kew Herbarium, and has thus been able to supplement her artistic proficiency with unexcelled facilities for botanical observation. She has had also the willing cooperation of the members of the staff of the Herbarium. Many specimens from the herbarium were examined in an effort to make the plants figured truly representative. Perhaps as a result of such a background, the figures seem the work of a botanist rather than of an artist—though technically no fault can be found with them.

This work should be invaluable to both amateur and professional botanists, and provides a model which might well be imitated in this country.—H. W. RICKETT.

NOTES

The thirty-fifth edition of **The Naturalists' Directory** has recently been published by the Cassino Press, Salem, Massachusetts. It contains names, addresses, and special subjects of study of professional and amateur naturalists of North and South America and some other countries, and a list of scientific periodicals and natural history museums.

Silva of North America, a description of the trees which grow naturally in North America exclusive of Mexico. By Charles Sprague Sargent. This work, long out of print and practically unobtainable at any price, has been reprinted by Peter Smith, 321 Fifth Avenue, New York. The original edition was published at $350, and sets have been sold for as much as $500. The reprinted edition consists of 200 sets, 14 volumes bound in 7, complete with all illustrations. The list price is $200.

Dr. John S. Karling has resigned from Columbia University to become Professor of Botany and Chairman of the Department of Biological Sciences at Purdue University, Lafayette, Indiana. Dr. Karling joined the Torrey Botanical Club in 1924, and served as Vice-President in 1930, Recording Secretary from 1933 to 1936, Corresponding Secretary from 1937 to 1940, and was President in 1941; he has also been Historian since the establishment of this office in 1943.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

TAXONOMY, PHYLOGENY AND FLORISTICS

ALGAE

Daily, William A. Notes on the algae—III. Butler Univ. Bot. Stud. **8:** 121, 122. *f. 1, 2.* My 1948.

Drouet, Francis & Daily, William A. Nomenclatural transfers among coccoid algae. Lloydia **11:** 77–79. Mr [Je] 1948.

Humm, H. J. & Williams, L. G. A study of agar from two Brazilian seaweeds. Am. Jour. Bot. **35:** 287–292. *f. 1–7 + tables 1–3.* My [8 Je] 1948.

Kenoyer, Fay. *Nitella capillata* A. Br. in North Carolina. Butler Univ. Bot. Stud. **8:** 123–125. *pl. 1.* My 1948.

Rohde, Wilhelm. Environmental requirements of fresh-water plankton algae; experimental studies in the ecology of phytoplankton. Symb. Bot. Upsal. **10**[1]**:** 1–30. 1948.

Taft, Clarence, E. Some algae from the Black Hills of South Dakota and the Turtle Mountain Region of North Dakota. [N. sp. without Latin diagn.] Ohio Jour. Sci. **48:** 84–88. *f. 1–7.* Mr [Je] 1948.

Williams, Louis G. The genus *Codium* in North Carolina. Jour. Elisha Mitchell Soc. **64:** 107–115. *pl. 9 + f. 1–3.* Je 1948.

FUNGI AND LICHENS

(See also under Morphology: **Brodie;** under Plant Pathology: **Rader; Welmer & Luttrell**)

Benham, Rhoda W. Effect of nutrition on growth and morphology of the Dermatophytes. 1. Development of macroconidia in *Trichophyton rubrum.* Mycologia **40:** 232–240. *f. 1, 2.* Mr–Ap [My] 1948.

Cain, Roy F. *Myriogonium,* a new genus among simplified Ascomycetes. Mycologia **40:** 158–167. *f. 1–56.* Mr–Ap [My] 1948.

Coker, W. C. Notes on some higher fungi. Jour. Elisha Mitchell Soc. **64:** 135–146. *pl. 16–25.* Je 1948.

DeLamater, Edward D. Basic fuchsin as a nuclear stain for fungi. Mycologia **40:** 423–429. *f. 1.* Jl–Au 1948.

DeLamater, Edward D. The nuclear cytology of *Blastomyces dermatitidis.* Mycologia **40:** 430–444. *f. 1–5.* Jl–Au 1948.

Harris, Hubert A. Heterothallic antibiosis in *Mucor racemosus.* Mycologia **40:** 347–351. My–Je [16 Je] 1948.

Jackson, H. S. & Dearden, E. R. *Martensella corticii* Thaxter and its distribution. Mycologia **40:** 168–176. *f. 1–11.* Mr–Ap [My] 1948.

Kanouse, Bessie B. The genus *Plectania* and its segregation in North America. Mycologia **40:** 482–497. *f. 1–12.* Jl–Au 1948.

Karling, John S. Keratinophilic chytrids. III. *Rhizopodium nodulosum* sp. nov. Mycologia **40:** 328–335. *f. 1–20.* My–Je [16 Je] 1948.

Latham, Roy. *Cetraria islandica* (L.) Ach. on Long Island, N. Y. IV. Bryologist **51:** 50, 51. Je 1948.

Lepage, l'abbé Ernest. Les lichens, les mousses et les hépatiques du Québec. Nat. Canad. **75:** 31–48, 90–96. 1948.

Long, W. H. Studies in the *Gasteromycetes* XVII. Two interesting species from Argentina. Lloydia **11:** 57–59. *f. 1–5.* Mr [Je] 1948.

Long, W. H. & Stouffer, David J. Studies in the *Gasteromycetes* XVIII. The phalloids of the southwestern United States. Lloydia **11:** 60–76. *f. 1–21.* Mr [Je] 1948.

Mains, E. B. Entomogenous fungi. Mycologia **40:** 402–416. *f. 1–4.* Jl–Au 1948.

Mattick, Fritz. Die Flechten der Hawaii-Inseln. Repert. Spec. Nov. **69:** 187–206. 1940.

Morse, Elizabeth Eaton. Variation in *Montagnites arenarium* (DC.). Mycologia **40:** 255–261. *f. 1–19.* Mr–Ap [My] 1948.

Mozingo, Hugh N. Western Pennsylvania lichens. Bryologist **51:** 38–46. Je 1948.

Murrill, William A. Florida boletes. Lloydia **11:** 21–35. Mr [Je] 1948.

Nyland, George. Preliminary observations on the morphology and cytology of an undescribed heterobasidiomycete from Washington state. Mycologia **40:** 478–481. *f. 1.* Jl–Au 1948.

Rader, Wm. E. *Helminthosporium portulacae* a new pathogen of *Portulaca oleraceae* L. Mycologia **40:** 342–346. *f. 1.* My–Je [16 Je] 1948.

Robert, John Maurice. Development studies of two species of *Nowakowskiella* Schroeter: *N. ramosa* Butler and *N. profusa* Karling. Mycologia **40:** 127–157. *f. 1, 2.* Mr–Ap [My] 1948.

Rogers, Donald P. The meaning of article 57 of the International Rules. Mycologia **40:** 241–254. Mr–Ap [My] 1948.

Romariz, C. & Santos, E. C. D. Notas criptogamicas. I. Fungos—1. Broteria **17:** 73–89. 1 My 1948.

Routien, John B. Hyphal proliferation through clamp-formation in *Polyporus cinnabarinus* Fr. Mycologia **40:** 194–198. *f. 1.* Mr–Ap [My] 1948.

Schatz, Albert & Hazen, Elizabeth L. The distribution of soil microorganism antagonistic to fungi pathogenic for man. Mycologia **40:** 461–477. *f. 1–3 + tables 1–5.* Jl–Au 1948.

Sharp, Aaron J. Some fungi common to the highlands of Mexico and Guatemala and eastern United States. Mycologia **40:** 499–502. Jl–Au 1948.

Singer, R. New genera of fungi—IV. Mycologia **40:** 262–264. Mr–Ap [My] 1948.

Smith, Alexander H. & Singer, Rolf. Notes on the genus *Cystoderma.* Mycologia **40:** 454–460. *f. 1.* Jl–Au 1948.

Sörgel, G. Über die Verbreitung einiger niederer Phycomyceten in Erden Westindiens. Beih. Bot. Centralbl. **61 B:** 1–32. *f. 1–4.* Je 1941.

Sparrow, F. K. Soil phycomycetes from Bikini, Eniwetok, Rongerik and Rongelap atolls. Mycologia **40:** 445–453. *f. 1–19 + table 1.* Jl–Au 1948.

Sprague, Roderick. Some leaf spot fungi on western Gramineae—II. Mycologia **40:** 177–183. *f. 1, 2.* Mr–Ap [My] 1948. III. 295–313. *f. 1, 2.* My–Je [16 Je] 1948.

Tai, T. L. Cercosporae of China—II. Lloydia **11:** 36–56. *f. 1–15.* Mr [Je] 1948.

Tehon, Leo R. Notes on the parasitic fungi of Illinois. Mycologia **40:** 314–327. *f. 1–15.* My–Je [16 Je] 1948.

Thirumalachar, M. J. & Chupp, Charles. Notes on some *Cercosporae* of India. Mycologia 40: 352–362. My–Je [16 Je] 1948.

Thirumalachar, M. J. & Cummins, George B. Status of the rust genera *Allopuccinia, Leucotelium, Edythea,* and *Ypsilospora.* Mycologia 40: 417–422. *f. 1–5.* Jl–Au 1948.

Trussell, Paul C. & Richardson, Edwin M. Actinomycin from a new *Streptomyces.* Canad. Jour. Res. C. 26: 27–30. F [Ap] 1948.

Viégas, A. P. Alguns fungos encontrados em S. Paulo, Minas e Espirito Santo. Bragantia 7: 107–124. *f. 1–10.* Ap 1947.

Viégas, A. P. Alguns micetos brasileiros. Bragantia 7: 25–48. *pl. 1–13.* F 1947.

Warren, John R. An undescribed species of *Papulospora* parasitic on *Rhizoctonia Solani* Kuhn. Mycologia 40: 391–401. *f. 1–3.* Jl–Au 1948.

Wehmeyer, L. E. The developmental pattern within the genus *Pleospora* Rab. Mycologia 40: 269–294. *f. 1–56.* My–Je [16 Je] 1948.

Ziegler, Arthur William. A comparative study of zygote germination in the Saprolegniaceae. Jour. Elisha Mitchell Soc. 64: 13–40. *pl. 1–6.* Je 1948.

Ziegler, A. W. A new species of *Achlya.* Mycologia 40: 336–341. *f. 1–10.* My–Je [16 Je] 1948.

BRYOPHYTES

Andrews, A. LeRoy. Taxonomic notes VI. The Leucobryaceae. Bryologist 50: 319–326. D 1947 [15 Mr] 1948.

Andrews, A. LeRoy. Taxonomic notes VII. The *Lophozia-Sphenolobus* complex. Bryologist 51: 33–37. Je 1948.

Bold, Harold C. The prothallium of *Sphagnum palustre* L. Bryologist 51: 55–63. *f. 1–17.* Je 1948.

Brinker, Robert R. *Plagiochila dotensis.* Bryologist 51: 1–4. *f. 1–20.* Mr [30 Ap] 1948.

Brinker, Robert R. *Plagiochila Standleyi.* Bryologist 51: 4–6. *f. 1–18.* Mr [30 Ap] 1948.

Brinker, Robert R. *Plagiochila tricarinata.* Bryologist 51: 7–9. *f. 1–17.* Mr [30 Ap] 1948.

Chapman, Clara J. & Sanborn, Ethel L. Moss flora of the Willamette Valley, Oregon. Oregon Monogr. Stud. Bot. 4: 3–72. *pl. 1–4.* Je 1941.

Clark, Lois & Frye, T. C. *Frullania intermedia.* Bryologist 51: 52–54. *f. 1–14.* Je 1948.

Clark, Lois & Frye, T. C. *Frullania spicata.* Bryologist 50: 313–316. *f. 1–19.* D 1947 [15 Mr 1948].

Clark, Lois & Svihla, Ruth Dowell. *Frullania convoluta.* Bryologist 50: 316–319. *f. 1–18.* D 1947 [15 Mr 1948].

Clark, Lois & Svihla, Ruth Dowell. *Frullania nodulosa.* Bryologist 50: 381–387. *f. 1–33.* D 1947 [15 Mr 1948].

Clark, Lois & Svihla, Ruth Dowell. Provisional keys to the Frullanias of Middle America. Bryologist 51: 17–27. Mr [30 Ap] 1948.

Clebsch, Alfred. *Bartramidula carolinae* in Tennessee. Bryologist 50: 376. D 1947 [15 Mr 1948].

Clebsch, Alfred. Bryophytes of the lower Cumberland River valley in Tennessee. Bryologist 50: 366–376. D 1947 [15 Mr 1948].

Harvill, A. M. Notes on the moss flora of Alaska. II. Mosses from the Mount McKinley region. Bryologist 50: 341–348. D 1947 [15 Mr 1948].

Koch, Leo Francis. Rediscovery of *Fissidens pauperculus* Howe. Bryologist **51:** 30, 31. Mr [30 Ap] 1948.

Kucyniak, James. A bryophytic flora of interest on Lac Des Cygnes Mountain, Quebec. Bryologist **50:** 327–340. D 1947 [15 Mr 1948].

Leal, Adrián Ruiz. Seis géneros de briofitas (hepáticas) nuevos para la flora mendocina. Anal. Soc. Ci. Argent. **145:** 24–33. *pl. 1–4.* 1948.

Meyer, Samuel L. Physiological studies on mosses. VI. Spore germination and protonema development in *Physcomitrium turbinatum* (Michx.) Brid. Bryologist **50:** 403–408. *f. 1–4.* D 1947 [15 Mr 1948].

Quarterman, Elsie. A preliminary survey of the bryophytes of two Cedar Glades [Tennessee]. Bryologist **50:** 377–380. D 1947 [15 Mr 1948].

Rakestraw, Lulu & Clark, Lois. *Metzgeria bractifera.* Bryologist **51:** 47–50. *f. 1–16.* Je 1948.

Sharp, Aaron J. Another coastal plain *Sphagnum* in Tennessee. Bryologist **50:** 402. D 1947 [15 Mr 1948].

Stair, Leslie Dalrymple. A contribution to the cryptogamic flora of Yakutat Bay, Alaska. Bryologist **50:** 349–365. D 1947 [15 Mr 1948].

PTERIDOPHYTES

(See also under Spermatophytes: **Löve & Löve**)

Benedict, R. C. A fern reference in seventeenth century literature. Am. Fern Jour. **38:** 55–58. My–Je [Au] 1948

Chandler, Albert. Working with fern spores. Am. Fern Jour. **38:** 12–16. Ja–Mr [6 My] 1948.

Clausen, Robert T. Nomenclatural and distributional notes on *Botrychium lanceolatum.* Am. Fern Jour. **38:** 45–47. Ap–Je [Au] 1948.

Diddell, Mary W. *Diplazium esculentum* in Florida. Am. Fern Jour. **38:** 16–19. Ja–Mr [6 My] 1948.

Dix, W. L. *Polystichum Braunii* in Bucks County, Pennsylvania. Am. Fern Jour. **38:** 61, 62. My–Je [Au] 1948.

Hunnewell, F. W. *Botrychium matricariaefolium* in West Virginia. Castanea **13:** 93. Je 1948.

McGilliard, Eleanor. The hart's-tongue in Tennessee in 1947. Am. Fern Jour. **38:** 48–52. My–Je [Au] 1948.

Martin, G. W. Fertile green shoots of *Equisetum arvense.* Proc. Iowa Acad. **53:** 167–169. *f. 1–4.* 1947 [My 1948].

Ramírez Cantú, Débora. Nota sobre los helechos de Tepoztlán, Mor. Anal. Inst. Biol. [Mexico] **18:** 463–472. *f. 1–5.* 1947 [1948].

Reed, Clyde F. Notes on the taxonomy of some eastern Asiatic ferns of the genera *Protowoodsia* and *Pteretis.* Madroño **9:** 189–193. *table 1.* Ap [Je] 1948.

Selling, Olof H. A peculiar *Asplenium* from the Hawaiian Islands. Occ. Pap. Bishop Mus. **19:** 171–184. *f. 1–6.* 14 My 1948.

Smith, Jesse F. Scott's spleenwort in Connecticut. Am. Fern Jour. **38:** 52–54. *pl. 4.* My–Je [Au] 1948.

Wagner, W. H. A new fern from Rota, Mariana Islands. Pacif. Sci. **2:** 214, 215. *f. 1.* Jl 1948.

Wagner, Warren H. & Grether, David F. Pteridophytes of Guam. Occ. Pap. Bishop Mus. **19:** 25–99. *f. 1–12.* 30 Ja 1948.

Weatherby, C. A. A proposed new genus and family of ferns. Am. Fern Jour. **38:** 58–61. My–Je [Au] 1948.

Weatherby, C. A. Reclassification of the Polypodiceae. Am. Fern Jour. **38:** 7–12. Ja–Mr [6 My] 1948.

SPERMATOPHYTES

Agramont, Felix *et al.* The red cedar. Mo. Bot. Gard. Bull. **36:** 86–92. *illust.* My 1948.

Akers, John. New species from Peru [*Peruvocereus clavatus*]. Cactus & Succ. Jour. **20:** 55, 56. *f. 35–37.* Ap 1948.

Allard, H. A. Vegetation and floral beauty in the mountains of the Dominican Republic. Wild Flower **24:** 53–64. *pl. 10–12.* Jl 1948.

Ames, Oakes. Color changes in *Epidendrum tampense.* Am. Orchid Soc. Bull. **16:** 442, 443. 1947.

Ames, Oakes. Resupination and pseudoresupination in *Trichopilia suavis.* Am. Orchid Soc. Bull. **16:** 370–372. 1947.

Amshoff, G. Jane H. Caesalpiniaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75:** 387–392. Jl 1948.

Amshoff, G. Jane H. Mimosaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75:** 383–387. Jl 1948.

Amshoff, G. Jane H. Papilionaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75:** 392–396. Jl 1948.

Amshoff, G. Jane H. Polygalaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75:** 398, 399. Jl 1948.

Amshoff, G. Jane H. & Henrard, J. Th. Gramineae. *In:* Flora of Suriname (Netherlands Guyana) 1: 273–442. Ja 1943.

Anthony, Harold E. *Rhipsalis* in the rain forest of Nyasaland. Des. Pl. Life **20:** 53, 54. *f. 1.* 1948.

Arnberger, Leslie. Flowering plants of ferns of the Walnut Canyon [Arizona]. Plateau **20:** 29–36. 1947.

Baker, Milo S. A new western violet [*V. quercetorum*]. Leafl. West. Bot. **5:** 101, 102. 24 My 1948.

Ballard, F. *Zauschneria Californica* [from California and northwestern Mexico]. Bot. Mag. **165:** *pl. 19+f. 1, 2.* Je 1948.

Boivin, B. Centurie de plantes canadiennes. Nat. Canad. **75:** 79–84. Mr–Ap 1948.

Boterenbrood, Magda J. A. Iridaceae. *In:* Flora of Suriname (Netherlands Guyana) 1: 455–460. Ja 1943.

Boterenbrood, Magda J. A. Amaryllidaceae. *In:* Flora of Suriname (Netherlands Guyana) 1: 443–454. Ja 1943.

Bowles, E. A. *Anemone hortensis* and *A. pavoninia:* a history of confusion. Jour. Roy. Hort. Soc. **73:** 57–70. *f. 13–16.* Mr. 1948.

Burkart, Arturo. Las especies de *Mimosa* de la flora argentina. Darwiniana **8:** 9–231. *pl. 1–26 + f. 1–39.* 8 Je 1948.

Camp, W. H. The names of plants in cultivation. Nat. Hort. Mag. **27:** 83–86. Ap 1948.

Camp, W. H. *Rhipsalis*—and plant distributions in the southern hemisphere. Jour. N. Y. Bot. Gard. **49:** 88–91. Ap 1948.

Chatterjee, D. Botanical nomenclature of the shaddock or pomelo. Nature **161**: 770. 1948.

Chessman, E. E. Classification of the bananas. II. The genus *Musa* L. Kew. Bull. **1947**: 106–117. Ap 1948.

Clausen, Robert T. A green-flowered *Sedum* [*S. chloropetalum*] from the Sierra del Sur. Cactus & Succ. Jour. **20**: 53, 54. *f. 33–34.* Ap 1948.

Core, Earl L. The flora of the Erie Islands; an annotated list of vascular plants. Contr. Ohio State Univ. **9**: *i–viii*, 1–106. *illust.* 1948.

Core, Earl L. The genus *Scleria* in Colombia. Caldasia 5^{21}: 17–32. 20 Mr 1948.

Core, Earl L. Spring wild flowers. W. Va. Conserv. Comm. (Charleston) 1–100. *illust.* 1948.

Correll, Donovan S. Wild potato collecting in Mexico. Field & Lab. **16**: 94–112. *illust.* Je 1948.

Cory, V. L. *Salsola collina* Pall. in Colorado. Leafl. West. Bot. **5**: 104. 24 My 1948.

Cory, V. L. Some first records of plant species collected in Texas. Field & Lab. **16**: 82–89. Je 1948.

Croizat, Leon. Euphorbiaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 400–408. Jl 1948.

Croizat, Leon. Nociones sobre las Euforbiáceas de Venezuela. I. Bol. Soc. Venez. Ci. Nat. **11**: 79–84. O–D 1947.

Croizat, Leon & Tamayo, Francisco. Una nueva especie de Cactáceas. Bol. Soc. Venez. Ci. Nat. **11**: 75–78. *1 pl.* O–D 1947.

Darrow, Robert A. Notes on the Arizona flora. Leafl. West. Bot. **5**: 93–100. 24 My 1948.

Davidson, John F. A new *Polemonium* [*glabrum*] from Mexico. Madroño **9**: 187–189. Ap [My] 1948.

Davis, R. The genus *Phreatia* in the Philippines. Orchid Digest **11**: 264–266. N–D 1947.

Dayton, William A. *Juglans nigra oblonga* in Missouri. Rhodora **50**: 147. 16 Je 1948.

Dugand, Armando. Algunas Leguminosas de la Amazonia y Orinoquia colombianas. Caldasia 5^{21}: 65–76. 20 Mr 1948.

Dugand, Armando. Noticias botánicas colombianas, X. Caldasia 5^{21}: 55–64. 20 Mr 1948.

Duncan, Wilbur H. Preliminary reports on the flora of Georgia—1. The distribution in Georgia of spermatophytes new or rare in the state. Castanea **13**: 70–83. *f. 1–3.* Je 1948.

Eastwood, Alice. Studies of Pacific Coast lilies—I. The identity of *Lilium Roezlii.* Leafl. West. Bot. **5**: 103, 104. 24 My 1948.

Ewan, Joseph. A review of *Purdieanthus* and *Lehmaniella,* two endemic Colombian genera of Gentianaceae, and biographical notes on Purdie and Lehman. Caldasia 5^{21}: 85–98. 20 Mr 1948.

Fanshawe, D. B. & Maguire, Bassett. Rosaceae [of Guiana]. *In:* Maguire, Bassett, *et al.,* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—III, IV. Bull. Torrey Club. **75**: 317–323. 12 My 1948. 374–382. Jl 1948.

Fernald, M. L. Some minor forms of *Rosa.* Rhodora **50**: 145–147. 16 Je 1948.

Fernald, M. L. Two forms in *Euphorbia.* Rhodora **50**: 148. 16 Je 1948.

Fernandes, A. & Fernandes, R. On the karyo-systematics of the sub-genus *Ajax* Spach of the genus *Narcissus* L. Herbertia **13**: 51–76. 1946 [1948].

l Finan, John J. Maize in the great herbals. Ann. Mo. Bot. Gard. 35: 149–191. *f. 1–25 + tables 1–4.* My [Jl] 1948.

Fosberg, F. Raymond & Walker, Egbert H. Second supplement to a preliminary check list of plants in the Shenandoah National Park. Castanea 13: 83–92. Je 1948.

Foster, Robert C. Studies in the Iridaceae, V. Contr. Gray Herb. 166: 3–27. 22 Je 1948.

Foster, Robert C. Studies in the Flora of Bolivia, II. Contr. Gray Herb. 166: 28–42. 22 Je 1948.

Fries, Rob. E. New or noteworthy Annonaceae from tropical America. Sv. Vet. Akad. Handl. III 24[10]: 1–20. *pl. 1–7.* 12 Ap 1948.

Germain, R. L'*Ambrosia psilostachys* DC., sa dispersion dans le Québec et ses particularités écologiques. Nat. Canad. 75: 77, 78. Mr–Ap 1948.

Gleason, H. A. Specific names in *Gratiola.* Phytologia 2: 503, 504. 9 Jl 1948.

Glendenning, R. The occurrence of a columnar form of the western red cedar. Canad. Field Nat. 62: 39, 40. *f. 1.* 1948.

Groh, Herbert. *Vicia sepium* L. in Canada. Rhodora 50: 144. 16 Je 1948.

Haddow, W. R. Distribution and occurrence of white pine (*Pinus strobus* L.) and red pine (*Pinus resinosa* Ait.) at the northern limit of their range in Ontario. Jour. Arnold Arb. 29: 217–226. *pl. 1–3.* 15 Jl 1948.

Harrington, H. D. Range exten ions of grasses into Colorado. Madroño 9: 199, 200. Ap [Je] 1948.

Hermann, F. J. Additions to the flora of Colombia. Caldasia 5[21]: 33–42. 1 *pl.* 20 Mr 1948.

Hodge, W. H. Lista préliminar de las plantas vasculares nativas del Departamento de Antioquia, Colombia. Revista Fac. Agron. [Medellin] 7: 267–324. 1947.

Howard, R. A. Icacinaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club 75: 411. Jl 1948.

Howard, Richard A. The morphology and systematics of the West Indian Magnoliaceae. Bull. Torrey Club 75: 335–357. *f. 1–36.* Jl 1948.

Howell, John Thomas. *Crepis setosa* in California. Leafl. West. Bot. 5: 100. 24 My 1948.

Howell, John Thomas. Hop clover in western America. Leafl. West. Bot. 5: 108. 24 My 1948.

Howell, John Thomas. New California stations for crested dogtail. Leafl. West. Bot. 5: 100. 24 My 1948.

Howell, John Thomas. New names for plants in Marin County, California. Leafl. West. Bot. 5: 105–108. 24 My 1948.

Howell, John Thomas. A noteworthy station for *Astragalus Clevelandii.* Leafl. West. Bot. 5: 100. 24 My 1948.

Hultén, Eric. Flora of Alaska and Yukon. VII. Dicotyledoneae: Rosales III, Geraniales, Sapindales, Parietales, Myrtiflorae, Umbelliflorae. Lunds Univ. Årssk. II Sect. 2 43[1]: 1069–1200. *maps 804–905.* 1947. VII. Ericales, Primulales, Contortae, Tubiflorae 1, (Polemoniaceae, Hydrophyllaceae). 44[1]: 1203–1341. *maps 906–995.* 1948.

Ibarra, Florinda E. & La Porte, Juan. Las Crucíferas del género *Rapistrum* adventicias en la Argentina. Revista Argent. Agron. 15: 81–89. *f. 1–3.* Je 1948.

Jacobsen, H. The genus *Adromischus* Lem. Des. Pl. Life 20: 55–58. 1948.

Johnston, Ivan M. Studies in the Boraginaceae, XVI. Species chiefly from Mexico and western United States. Jour. Arnold Arb. **29**: 227–241. 15 Jl 1948.

Jonker, F. P. Alismataceae. *In:* Flora of Suriname (Netherlands Guyana) **1**: 472–482. Ja 1943.

Jonker, F. P. Butomaceae. *In:* Flora of Suriname (Netherlands Guyana) **1**: 483–485. Ja 1943.

Jonker, F. P. Hydrocharitaceae. *In:* Flora of Suriname (Netherlands Guyana) **1**: 467–471. Ja 1943.

Jonker, F. P. Triuridaceae. *In:* Flora of Suriname (Netherlands Guyana)**1**: 461–466. Ja 1943.

Kelso, Leon. The Rocky Mountain flora. IV. Salices monticolae. Biol. Leafl. **41**: 1–4. *pl. 1, 2.* 25 Je 1948.

Killip, E. P. Passifloraceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 415–417. Jl 1948.

Kobuski, C. E. Ternstroemiaceae [of Guiana]. *In:* Maguire, Bassett *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 412–414. Jl 1948.

Larsen, Esther L. New species of *Achaetogeron* (Compositae) from Mexico. Jour. Wash. Acad. **38**: 199–201. 15 Je 1948.

Little, E. L. David Douglas' new species of conifers. Phytologia **2**: 485–490. 9 Jl 1948.

Little, E. L. Notes on nomenclature of trees. Phytologia **2**: 457–463. 9 Jl 1948.

Löve, Askell & Löve, Doris. Chromosome numbers of northern plant species. Reykjavik Univ. Inst. Appl. Sci. Dep. Agr. Rep. B **3**: 1–131. 1948.

Luces de Febres, Zoraida. Gramineas nuevas o interesantes para la flora venezolana. Bol. Soc. Venez. Ci. Nat. **11**: 29–35. Au–S 1947

McDougall, W. B. Plants of Grand Canyon National Park. Revised check list. 3rd ed. Grand Canyon Nat. Park Hist. Assoc. Bull. **10**: 1–126. Ja 1947.

Maguire, Bassett *et al.* Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 374–438. *f. 18–22.* Jl 1948.

Martínez, Maximino. Los *Cupressus* Mexicanos. Soc. Bot. Mex. Bol. **2**: 1–6. *illust.* Mr 1948.

Martínez Crovetto, R. La naturalización de *Acacia melanoxylon* en Belcarce (Provincia de Buenos Aires). Buenos Aires Inst. Bot. P. Tec. N. S. **8**: 101, 102. 1947.

Merrill, E.D. A note on Philip Miller's binomials. Jour. Arnold Arb. **29**: 242–244. 15 Jl 1948.

Merrill, E. D. Unlisted binomials in Chapman's Flora of the southern United States. Castanea **13**: 61–70. Je 1948.

Moldenke, H. N. Additional notes on the genus *Amasonia.* III. Phytologia **2**: 502. 9 Jl 1948.

Moldenke, H. N. Additional notes on the genus *Petrea* IV. Phytologia **2**: 499–502. 9 Jl 1948.

Moldenke, H. N. The known geographic distribution of the members of the Eriocaulaceae. Supplement 3. Phytologia **2**: 490–499. 9 Jl 1948.

Moldenke, Harold N. The known geographic distribution of the members of the Verbenaceae and Avicenniaceae. Supplement 5. Bol. Soc. Venez. Ci. Nat. **11**: 37–52. Au-S 1947.

Moldenke, H. N. The known geographic distribution of the members of the Verbenaceae, Avicenniaceae, Stilbaceae, and Symphoremaceae. Supplement 9. Phytologia **2**: 477–483. 9 Jl 1948.

Moldenke, Harold N. A monograph of the genus *Bouchea*. II. Repert. Spec. Nov. **39**: 91–139. 1940.

Moldenke, H. N. Notes on new or noteworthy plants. V. Phytologia **2**: 464–477. 9 Jl 1948.

Moldenke, H. N. The seacoast *Angelica* in the local area. Bull. Torrey Club **75**: 439. Jl 1948.

Monachino, J. V. *Capparis brevis* Sprengel is a *Glyphaea*. Phytologia **2**: 484. 9 Jl 1948.

Mulligan, B. O. Plants of Mount Angeles, Olympic Peninsula, Washington. Quart. Bull. Alpine Gard. Soc. **15**: 245–259. D 1947.

Oostroom, S. J. van. Portulacaceae. *In:* Flora of Suriname (Netherlands Guyana) **1**: 486–491. Ja 1943.

Paray, Ladislao. A través de la Sierra Madre occidental. Soc. Bot. Mex. Bol. **6**: 7–13. Mr 1948.

Parthasarathy, N. Origin of noble sugar-cane (*Saccharum officinarum* L.) Nature **161**: 608. 1948.

Pichon, M. Classification des Apocynacées: VI. Genre *Tabernaemontana*. [Some S. Am. sp.] Not. Syst. [Paris] **13**: 230–253. Ja 1948.

Pittier, H. Especies venezolanas nuevas o supuestas como tales. Bol. Soc. Venez. Ci. Nat. **11**: 13–28. Au–S 1947.

Porsild, Morten P. Stray contributions to the flora of Greenland XIII–XVIII. Medd. Grønl. **134**^{4}: 1–39. *f. 1–9.* 1946.

Pulle, A. *ed*, Flora of Suriname (Netherlands Guyana). vol. 1 part 1. K. Vereen. Indisch Inst. (Afdeel. Handelsm. 11) Med. **30**: 273–524. Ja 1943 [Ap 1948].

Radford, Albert E. The vascular flora of the Olivine deposits of North Carolina and Georgia. Jour. Elisha Mitchell Soc. **64**: 45–106. *pl. 8* + *f. 1–3.* Je 1948.

Ragonese, A. E. & Castiglioni, J. A. Nueva especie del género *Schinopsis* y area geográfica de las especies argentinas. Buenos Aires Inst. Bot. P. Tec. II. **7**: 93–100. 1947.

Raymond, Marcel & Kucyniak, James. Six additions to the adventitious flora of Québec. Rhodora **50**: 176–180. Jl 1948.

Reko, B. P. Apuntes sobre la flora de Guerrero. Soc. Bot. Mex. Bol. **6**: 15–25. Mr 1948.

Reko, B. P. Una Sapotacea nueva para México. Soc. Bot. Mex. Bol. **6**: 27, 28. *1 f.* Mr 1948.

Rizzini, Carlos Toledo. Estudos sôbre as Acanthaceae. Disquisitiones in Acanthaceis. Bol. Mus. Nac. [Rio de Janeiro] II. **8**: 1–38. *pl. 1–11.* 10 Jl 1947.

Royen, G. van. Podostemaceae [of Guiana]. *In:* Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 382, 383. Jl 1948.

Sandwith, N. Y. *Asteranthera ovata* [from Southern Chile and adjacent Argentina]. Bot. Mag. **165**: *pl. 15* + *f. 1.* Je 1948.

Seibert, R. J. The use of glands in a taxonomic consideration of the family Bignoniaceae. Ann. Mo. Bot. Gard. **35**: 123–136. *pl. 1–7.* My [Jl] 1948.

Seibert, R. J. The uses of *Hevea* for food in relation to its domestication. Ann. Mo. Bot. Gard. **35**: 117–121. My [Jl] 1948.

Senior, R. M. The flora of Big Bend National Park. Quart. Bull. Alp. Gard. Soc. **15**: 305–309. D 1947.

Smith, A. C. Hippocrataceeae [of Guiana]. *In:* Maguire, Bassett, *et al.*, Plant explorations in Guiana in 1944, chiefly to the Tafelberg and the Kaieteur Plateau—IV. Bull. Torrey Club **75**: 409, 410. Jl 1948.

Smith, Lyman B. Bromeliáceas notables de Colombia, IV. Caldasia **5**^{21}: 1–15. *illust.* 20 Mr 1948.

Smith, Lyman B. & Idrobo, J. M. Marantáceas nuevas de Colombia. Caldasia **5**^{21}: 43–54. *illust.* 20 Mr 1948.

Stebbins, G. L. The chromosomes and relationships of *Metasequoia* and *Sequoia.* Science **108**: 95–98. *f. 1, 2.* 30 Jl 1948.

Steyermark, Julian A. *Orthrosanthus chimboracensis* and its varieties (Iridaceae). Lloydia **11**: 14–20. Mr [Je] 1948.

Tortorelli, Lucas A. Estudio dendrológico de las especies *Piptadenia* de la flora Argentina. Revista Argent. Agron. **15**: 90–112. *pl. 1–6* + *f. 1.* Je 1948.

Traub, H. P. *Amaryllis moreliana* (Lemaire) Traub, comb. nov. Herbertia **13**: 102, 103. 1946 [1948].

Traub, H. P. Terminology for the floral envelope of Amaryllidaceae. Herbertia **13**: 98–100. 1946 [1948].

Traub, H. P. *Zephyranthes longifolia.* Herbertia **13**: 101, 102. 1946 [1948].

Uitewaal, A. J. A. *Astroloba herrei* Uitew. spec. nov. Des. Pl. Life. **20**: 37–39. Mr 1948.

Uittien, H. Cyperaceae—additions and corrections to Vol. 1 part 1 [of Flora of Suriname]. *In:* Flora of Suriname (Netherlands Guyana) **1**: 492–505. Ja 1943.

Uphof, J. C. T. Linnaeus confirms Dr. Hill's identification of *Amaryllis belladonna* Linn. Herbertia **13**: 97, 98. 1946 [1948].

Uribe-Uribe, Lorenzo. Sertula florae Colombiae, I. Caldasia **5**^{21}: 77–83. *illust.* 20 Mr 1948.

Weber, William A. The genus *Helianthella* in Oregon. Madroño **9**: 186, 187. Ap [Je] 1948.

Wherry, Edgar T. Wild flower guide: northeastern and midland United States. i-xv, 1–202. *pl. 1–106.* Doubleday. Garden City. 1948.

White, C. T. A new species of *Austrobaileya* (Austrobaileyaceae) from Australia. Jour. Arnold Arb. **29**: 255, 256. 15 Jl 1948.

Woodson, Robert E. *Gynandropsis, Cleome,* and *Podandrogyne.* Ann. Mo. Bot. Gard. **35**: 139–146. My [Jl] 1948.

PALEOBOTANY

(See also under Spermatophytes: **Stebbins**)

Cain, Stanley, A. Palynological studies at Sodon Lake: I. Size-frequency study of fossil spruce pollen. Science **108**: 115–117. *f. 1–3* + *table 1.* 30 Jl 1948.

Levittan, Edwin D. & Barghoorn, Elso S. *Sphenostrobus Thompsonii*, a new genus of the Sphenophyllales? Am. Jour. Bot. **35**: 350–357. *f. 1–12.* Je [Jl] 1948.

Lundblad, Britta. On some *Caytonia*-like plant-remains from the coal mines of Bjuv in Scania (Rhaetic). Sv. Bot. Tidsk. **42**: 84–86. *f. 1, 2.* 1948.

Potzger, John E. A pollen study in the tension zone of lower Michigan. Butler Univ. Bot. Stud. **8**: 161–177. My 1948.

Potzger, John E. & Friesner, Ray C. Forests of the past along the coast of southern Maine. Butler Univ. Bot. Stud. **8**: 178–203. My 1948.

Puri, G. S. Fossil plants and the Himalayan uplift. Jour. Indian Bot. Soc. Iyengar Commemoration Vol.: 167–184. *pl. 1–2,* + *f. 1.* 1947.

Spackman, William. A dicotyledonous wood found associated with the Idaho Tempskyas. Ann. Mo. Bot. Gard. **35:** 107–115. *pl. 1, 2.* My [Jl] 1948.

Weaver, Jack R. Fossil diatoms from Lakeville Bog, Indiana. Butler Univ. Bot. Stud. **8:** 126–138. My 1948.

ECOLOGY AND PLANT GEOGRAPHY

(See also under Spermatophytes: **Germain**)

Acosta-Solis, M. Soil erosion in the agricultural highlands of Ecuador and suggestions for its protection by appropriate plants, principally by *Setaria cernua* H. B. K. 1–19 *pl. 1–4.* Chicago. 29 D 1947 [Processed].

Currie, B. W. The vegetative and frost-free seasons of the prairie provinces and the Northwest Territories [Canada]. Canad. Jour. Res. C. **26:** 1–14. *f. 1–5.* F [Ap] 1948.

Detling, LeRoy E. Concentration of environmental extremes as the basis for vegetation areas. Madroño **9:** 169–185. *f. 1–6* + *table 1.* Ap [Je] 1948.

Evenari, Michael & Orshansky, Gideon. The middle eastern hammadas. Lloydia **11:** 1–13. *f. 1–4* + *tables 1, 2.* Mr [Je] 1948.

Gleason, H. A. An early ascent of Cerro de la Punta. Am. Fern Jour. **38:** 1–7. Ja–Mr [My] 1948.

Griffin, Charles D. A study of abundance of stems per acre in relation to age of stand. Butler Univ. Bot. Stud. **8:** 219–232. *tables 1–8.* My 1948.

Haumann, L. *et al.,* La vegetación de la Argentina. Geografía de la Republica Argentina. **8:** 1–349. *f. 1–125.* 1947.

Potzger, John E. & Potzger, Esther W. Progress in succession in the Pennington Grove of *Pinus virginiana.* Butler Univ. Bot. Stud. **8:** 153–160. My 1948.

Selling, Olof H. Studies in Hawaiian pollen statistics. Part II. The pollens of the Hawaiian phanerogams. Bishop Mus. Spec. Publ. **38:** 1–430. *pl. 1–58.* 1947.

Shimek, Bohumil. The plant geography of Iowa. Univ. Iowa Stud. Nat. Hist. **18:** 1–178. 1948.

Wiggins, Ira L. The effects of prolonged drought on the vegetation in southern Baja California. Cactus & Succ. Jour. **20:** 49–51. Ap 1948.

PHYTOPATHOLOGY

(See also under Fungi: **Sprague; Thirumalacher & Cummins;** under Genetics: **Gerste**[1])

Andreae, W. A. The isolation of a blue fluorescent compound scopoletin, from Green Mountain Potato tubers, infected with leaf roll cirus. Canad. Jour. Res. C. **26:** 31–34. *f. 1.* F [Apr] 1948.

Baker, Kenneth F. *Fusarium* wilt of garden stock (*Mathiola incana*). Phytopathology **38:** 399–403. *f. 1, 2.* My [Je] 1948.

Berk, Sigmund. Inoculation experiments with *Polyporus schweinitzii.* Phytopathology **38:** 370–377. *f. 1, 2.* + *table 1.* My [Je] 1948.

Burkholder, Walter H. & Starr, Mortimer. The generic and specific characters of phytopathogenic species of *Pseudomonas* and *Xanthomonas.* Phytopathology **38:** 494–502. Je 1948.

Cormack, M. W. Winter crown rot or snow mold of alfalfa, clovers, and grasses in Alberta [Canada]. Canad. Jour. Res. C. **26:** 71–85. *f. 1–30.* F[Apr] 1948.

Crandall, Bowen S. *Pellicularia* target spot leaf disease of Kenaf and Roselle. Phytopathology **38:** 503–505. *f. 1.* Je 1948.

Fulton, Robert W. Hosts of tobacco streak virus. Phytopathology **38:** 421–428. *f. 1, 2 + table 1.* Je 1948.

Grogan, Raymond G. & Walker, J. G. Interrelation of bean virus 1 and bean virus 2 as shown by cro.s-protection tests. Phytopathology **38:** 489–493. *tables 1–3.* Je 1948.

Hahn, Glenn Gardner. Immunity of Canadian black currant selections from blister rust. Phytopathology **38:** 452–456. Je 1948.

Hardison, John R. Field control of blind seed disease of perennial ryegrass in Oregon. Phytopathology **38·** 404–419. *f. 1 + tables 1–3.* My [Je] 1948.

Heiberg, Barbara C. & Ramsey, G. B. *Phoma* rot of garden beets. Phytopathology **38:** 343–347. *f. 1, 2.* My [Je] 1948.

Holmes, Francis O. Resistance to spotted wilt in tomato. Phytopathology **38:** 467–473. *f. 1 + table 1.* Je 1948.

Hovey, Charles & Bonde, Reiner. *Physalis angulata,* a test plant for the potato leafroll virus. Phytopathology **38:** 505–507. *f. 1.* Je 1948.

Keitt, G. W., Leben, Curt & Shay, J. R. *Venturia inaequalis* (Cke.) Wint. IV. Further studies on the inheritance of pathogenicity. Am. Jour. Bot. **35:** 334–336. *table 1.* Je [Jl] 1948.

Langford, Arthur N. Autogenous necrosis in tomatoes immune from *Cladosporium fulvum* Cooke. Canad. Jour. Res. C. **26:** 35–64. *f. 1–5.* F [Apr] 1948.

Large, John R. Canker of tung trees caused by *Physalospora rhodina.* Phytopathology **38:** 359–363. *tables 1, 2.* My [Je] 1948.

McCallan, S. E. A. Characteristic curve for the action of copper sulfate on the germination of spores of *Sclerotina fructicola* and *Alternaria oleracea.* Contr. Boyce Thompson Inst. **15:** 77–90. *f. 1–3.* 1948.

Parris, G. K. Influence of soil moisture on the growth of the potato plant and its infection by the root-knot nematode. Phytopathology **38:** 480–488. *tables 1–3.* Je 1948.

Patch, L. H. & Everly, Ray T. Contribution of inbred lines to the resistance of hybrid dent corn to larvae of the early summer generation of the European corn borer. Jour. Agr. Res. **76:** 257–263. *f. 1 + table 1.* 1 Je 1948.

Person, L. H., Olson, E. O. & Martin, W. J. Effectiveness of fungicides in controlling black rot of sweet potatoes. Phytopathology **38:** 474–479. *f. 1, 2 + tables 1–3.* Je 1948.

Peturson, B. *et al.* Further studies on the effect of leaf rust on yield, grade, and quality of wheat. Canad. Jour. Res. C. **26:** 65–70. F [Apr] 1948.

Rader, Wm. E. *Rhizoctonia carotae* n. sp. and *Gliocladium aureum* n. sp., two new root pathogens of carrots in cold storage. Phyotopathology **38:** 440–452. *f. 1–5.* Je 1948.

Silberschmidt, Karl M. Infectious chlorosis of *Phenax sonneratii.* Phytopathology **38:** 395–398. *f. 1, 2.* My [Je] 1948.

Suit, R. F. Effect of copper injury on Concord grapes. Phytopathology **38:** 457–466. *tables 1–7.* Je 1948.

Sylvester, Edward S. The yellow-net virus disease of sugar beet. Phytopathology **38:** 429–439. *f. 1, 2.* Je 1948.

Tapke, V. F. Environment and the cereal smuts. Bot. Rev. **14:** 359–412. Je 1948.

Tims, E. C. White rot of shallot. Phytopathology **38:** 378–394. *f. 1–4 + tables 1–7.* My [Je] 1948.

Vasudeva, R. S. & Sam Raj, J. A leaf-curl disease of tomato. Phytopathology **38**: 364–369. *f. 1–3.* My [Je] 1948.

Weimer, J. L. & Luttrell, E. S. Angular leaf spot of kudzu caused by a new species of *Mycosphaerella.* Phytopathology **38**: 348–358. *f. 1–3.* My [Je] 1948.

Yu, T. F. & Fang, C. T. *Fusarium* diseases of broad bean. II. Further studies on broad bean wilt caused by *Fusarium avenaceum* var. *fabae.* Phytopathology **38**: 331–342. *f. 1–3 + tables 1, 2.* My [Je] 1948.

MORPHOLOGY

(including anatomy & cytology in part)

(See also under Fungi: **DeLamater**; under Bryophytes: **Meyer**; under Spermatophytes: **Howard**; under Genetics: **White**; under Plant Physiology: **Ryland**)

Artschwager, E. Vegetative characteristics of some wild forms of *Saccharum* and related grasses. Tech. Bull. U. S. Dep. Agr. **951**: 1–69. 1948.

Bailey, I. W. & Swamy, B. G. L. *Amborella trichopoda* Baill., a new morphological type of vesselless dicotyledon. Jour. Arnold Arb. **29**: 245–254. *pl. 1–5.* 15 Jl 1948.

Brodie, Harold J. Tetrapolarity and unilateral diploidization in the bird's nest fungus *Cyathus stercereus.* Am. Jour. Bot. **35**: 312–320. *f. 1–31 + tables 1–3.* My [8 Je] 1948.

Cave, Marion S. Sporogenesis and embryo sac development of *Hesperocallis* and *Leucocrinum* in relation to their systematic position. Am. Jour. Bot. **35**: 343–349. *f. 1–18 + table 1.* Je [Jl] 1948.

Dermen, H. Histogenesis of some bud sports and variegations. Proc. Am. Soc. Hort. Sci. **50**: 51–73. D 1947.

Dormer, K. J. & Street, H. E. Secondary thickening in excised tomato roots. Nature **161**: 483. 1948.

Fagerlind, Folke. Macrogametophyte formation in two agamospermous *Erigeron* species. Acta Horti Berg. **14**: 221–247. *f. 1–5.* 1947.

Garber, E. D. A reciprocal translocation in *Sorghum versicolor* Anderss. Am. Jour. Bot. **35**: 295–297. *f. 1 + tables 1–3.* My [8 Je] 1948.

Inforzato, R. Estudo do sistema radicular de *Tophrosia candida* DC. Bragantia **7**: 49–54. F 1947.

Matzke, Edwin B. The three-dimensional shape of epidermal cells of the apical meristem of *Anacharis densa* (Elodea). Am. Jour. Bot. **35**: 323–332. *f. 1–33 + tables 1–6.* Je [Jl] 1948.

Moreira, Silvio *et al.* Poliembrionia em *Citrus.* Bragantia **7**: 69–106. *pl. 3–6.* Mr 1947.

Philipson, W. R. Studies in the development of the inflorescence. V. The raceme of *Lobelia Dortmanna* L., and other Campanulaceous inflorescences. Ann. Bot. **12**: 147–156. *pl. 1 + f. 1–2.* Ap 1948.

Stratton, Robert. Origin of cotyledons in the Leguminosae. Proc. Okla. Acad. **27**: 75, 76. 1947.

Stratton, Robert. The significance of stipules in the Leguminosae. Proc. Okla. Acad. **27**: 76, 77. 1947.

Swamy, B. G. L. Vascular anatomy of orchid flowers. Bot. Mus. Leafl. **13**: 61–95. *f. 1–11.* 27 Jl 1948.

Wardlaw, C. W. Experimental and analytical studies of Pteridophytes. XI. Preliminary observations on tensile stress as a factor in fern phyllotaxis. Ann. Bot. **12**: 97–109. *pl. 1 + f. 1–4.* Ap 1948.

Wilkinson, Antoinette Miele. Floral anatomy and morphology of some species of the tribe Lonicerae of the Caprifoliaceae. Am. Jour. Bot. **35**: 261–271. *f. 1–14.* My [8 Je] 1948.

GENETICS

(Including cytogenetics)

(See also under Phytopathology: **Patch**; under Morphology: **Garber**)

Bateman, A. J. Contamination in seed crops. III. Relation with isolation distance. Heredity **1**: 303–336. D 1947.

Curtis, L. C. & Scharchuk, J. A bisex sterile variant of *Cucurbita pepo.* Jour. Hered. **39**: 32. Ja [Ap] 1948.

Darrow, George M. *et al.* The nature of giant apple sports. Jour. Hered. **39**: 44–51. *f. 1–6.* F [My] 1948.

Dermen, H. & Darrow, G. M. A tetraploid sport of McIntosh apples. Jour. Hered. **39**: 17. Ja [Ap] 1948.

Elliott, F. C. & Love, R. M. The significance of meiotic chromosome behavior in breeding smooth bromegrass, *Bromus inermis* Leyss. Jour. Am. Soc. Agron. **40**: 335–341. Ap 1948.

Gardner, V. R., Toenjes, W. & Giefel, M. Segregation in a radially unsymmetrical sport of the Canada red apple. Jour. Agr. Res. **76**: 241–255. *f. 1–3 + tables 1–8.* 1 Je 1948.

Gardner, V. R., Toenjes, W. & Giefel, M. Segregation in russeted sports of the Grimes apple. Jour. Agr. Res. **76**: 225–229. *f. 1 + tables 1, 2.* 1 Je 1948.

Gardner, V. R., Toenjes, W. & Giefel, M. Variability and segregation in the Golden Russet apple. Jour. Agr. Res. **76**: 231–240. *f. 1–5 + tables 1–5.* 1 Je 1948.

Gerstel, D. U. Transfer of the mosaic-resistance factor between H chromosomes of *Nicotiana glutinosa* and *N. tabacum.* Jour. Agr. Res. **76**: 219–223. My 1948.

Huskins, C. Leonard & Steinitz, Lotti. The nucleus in differentiation and development. Jour. Hered. **39**: 34–43. *f. 1, 2.* F [My] 1948.

Johnson, A. G. Albinism in the Austrian pine. Jour. Hered. **39**: 9, 10. Ja [Ap] 1948.

Love, R. Merton. Preliminary cytological studies of *Ehrhartia calycina* Smith. Am. Jour. Bot. **35**: 358–360. *f. 1–6 + tables 1–4.* Je [Jl] 1948.

Richey, F. R. & Dawson, R. F. A survey of the possibilities and method of breeding high niacin corn (maize). Plant Physiol. **23**: 238–254. Ap [Je] 1948.

Roever, W. E. A promising type of male sterility for use in hybrid tomato seed production. Science **107**: 506. 14 My 1948.

Sachet, Marie-Hélene. Fertilization in six incompatible species crosses of *Datura.* Am. Jour. Bot. **35**: 302–309. *f. 1–21.* My [8 Je] 1948.

Shifriss, O. Developmental reversal of dominance in *Cucurbita pepo.* Proc. Am. Soc. Hort. Sci. **50**: 330–346. D 1947.

Singh, H. B. *et al.* Inheritance of sex forms in *Luffa acutangula* Roxb. Nature **161**: 775, 776. 1948.

Tysdal, H. M. & Crandall, B. H. The polycross progeny performance as an index of the combining ability of alfalfa clones. Jour. Am. Soc. Agron. **40**: 293–306. Ap 1948.

Vanderlyn, Leon. Somatic mitosis in the root tip of *Allium cepa*—a review and a reorientation. Bot. Rev. **14**: 270–318. My 1948.

White, Orland E. Fasciation. Bot. Rev. **14**: 319–358. Je 1948.

PLANT PHYSIOLOGY

(See also under Genetics: **Richey & Dawson**)

Aaron, Isidor. Growth of stumps. Science **107**: 391, 392. 16 Apr 1948.

Arle, H. Fred, Leonard, O. A. & Harris, V. C. Inactivation of 2,4-D on sweet potato slips with activated carbon. Science **107**: 247, 248. 5 Mr 1948.

Barnett, H. L., Lilly, Virgil Greene. The interrelated effects of vitamins, temperature, and pH upon vegetative growth of *Sclerotinia camelliae*. Am. Jour. Bot. **35**: 297–302. *f. 1 + table 1.* My [8 Je] 1948.

Brian, P. W., Hemming, H. G., & Jefferys, E. G. Production of antibiotics by species of *Myrothecium*. Mycologia **40**: 363–368. My–Je [16 Je] 1948.

Burton, Margaret O., *et al.* The mineral requirements for pyocyanin production. Canad. Jour. Res. C. **26**: 15–22. F [Ap] 1948.

Calvin, M. & Benson, A. A. The path of carbon in photosynthesis. Science **107**: 476–480. 7 My 1948.

Correia, Francisco Alves. Acido cianidrico em algumas variedades de mendioca. Bragantia **7**: 15–22. Ja 1947.

Curtis, J. T. & Nichol, Marion Alfred. Culture of proliferating orchid embryos in vitro. Bull. Torrey Club **75**: 358–373. *f. 1–23.* Jl 1948.

Davis, Edwin A. Photosynthetic studies with mutant strain of *Chlorella*. Science **108**: 110, 111. 30 Jl 1948.

Denny, F. E. Effect upon plant respiration caused by changes in the oxygen concentration in the range immediately below that of normal air. Contr. Boyce Thompson Inst. **15**: 61–70. 1948.

Dufrenoy, Jean & Pratt, Robertson. Histo-physiological localization of the site of reducing activity in stalks of sugar cane. Am. Jour. Bot. **35**: 333, 334. Je [Jl] 1948.

Eaton, F. M. & Ergle, D. R. Carbohydrate accumulation in the cotton plant at low moisture levels. Plant Physiol. **23**: 169–187. *f. 1, 2.* Ap [Je] 1948.

Gainey, P. L. The significance of available calcium as a factor limiting growth of *Aztobacter* at pH levels below 6.0 Jour. Agr. Res. **76**: 265–270. *tables 1–4.* 1 Je 1948.

Galston, Arthur W. On the physiology of root initiation in excised asparagus stem tips. Am. Jour. Bot. **35**: 281–287. *f. 1–5 + tables 1, 2.* My [8 Je] 1948.

Granick, S. Protoporphyrin 9 as a precursor of chlorophyll. Jour. Biol. Chem. **172**: 717–727. 1948.

Hewitt, Eric J. Relation of manganese and some other metals to the iron status of plants. Nature **161**: 489, 490. 1948.

Jillson, Otis F. & Nickerson, Walter J. Mutual antagonism between pathogenic fungi. Inhibition of dimorphism in *Candida albicans*. Mycologia **40**: 369–385. *f. 1, 2.* My–Je [16 Je] 1948.

Leben, Curt & Keitt, G. W. *Venturia inaequalis* (Cke.) Wint. V. The influence of carbon and nitrogen sources and vitamins on growth in vitro. Am. Jour. Bot. **35**: 337–343. *f. 1–4 + tables 1–5.* Je [Jl] 1948.

Leonard, O. A., Anderson, W. S. & Gieger, M. Effect of nutrient level on the growth and chemical composition of sweetpotatoes in sand culture. Plant Physiol. **23**: 223–237. *f. 1–5.* Ap [Je] 1948.

Leukel, R. W. Recent developments in seed treatment. Bot. Rev. **14:** 235–269. My 1948.

Lewis, Ralph W. Mutants of *Neurospora* requiring succinic acid or a biochemically related acid for growth. Am. Jour. Bot. **35:** 292–295. *f. 1 + table 1.* My [8 Je] 1948.

Loehwing, W. F. The developmental physiology of seed plants. Science **107:** 529–533. 21 My 1948.

Nutman, P. S. Physiological studies on nodule formation. I. The relation between nodulation and lateral root formation in red clover. Ann. Bot. **12:** 81–96. *f. 1–4.* Ap [Je] 1948.

Pais de Camargo, A. Corte de tuberculos de cara (*Dioscorea alata* L.). Bragantia **7:** 55–68. *pl. 1, 2.* Mr 1947.

Perlman, D. On the nutrition of *Sclerotium delphinii.* Am. Jour. Bot. **35:** 360–363. *tables 1, 2.* Je [Jl] 1948.

Putman, E. W. *et al.* Preparation of radioactive carbon-labeled sugars by photosynthesis. Jour. Biol. Chem. **173:** 785–795. *f. 1, 2.* Ap 1948.

Ryland, Alice G. A cytological study of the effects of colchicine, indole-3-acetic acid, potassium cyanide, and 2,4-D on plant cells. Jour. Elisha Mitchell Soc. **64:** 117–125. *pl. 10–14.* Je 1948.

Scarth, G. W., Loewy, A., & Shaw, M. Use of the infrared total absorption method for estimating the time course of photosynthesis and transpiration. Canad. Jour. Res. C. **26:** 94–107. *f. 1–9.* F [Ap] 1948.

Schrank, A. R. Electrical and curvature responses of the *Avena* coleoptile to transversely applied direct current. Plant Physiol. **23:** 188–200. *f. 1–7.* Ap [Je] 1948.

Spoerl, Edward & Curtis, J. J. Studies on the nitrogen nutrition of orchid embryos. III. Amino acid nitrogen. Am. Orchid Soc. Bull. **17:** 307–312. My 1948.

Steinberg, Robert A. Effect of trace elements on growth of *Aspergillus niger* with amino acids. Jour. Agr. Res. **64:** 455–475. 1943.

Stiles, I. E. Relation of water to the germination of corn and cotton seeds. Plant Physiol. **23:** 201–222. *f. 1–6.* Ap [Je] 1948.

Thimann, Kenneth & Bonner, Walter D. Experiments on the growth and inhibition of isolated plant parts. I. The action of iodoacetate and organic acids on the *Avena* coleoptile. Am. Jour. Bot. **35:** 271–281. *f. 1–12 + tables 1–3.* My [8 Je] 1948.

Tsui, Cheng. The effect of zinc on water relation and osmotic pressure of the tomato plant. Am. Jour. Bot. **35:** 309–311. *tables 1, 2.* My [8 Je] 1948.

Weintraub, Robert L. Influence of light on chemical inhibition of lettuce seed germination. Smith. Misc. Coll. **107**[20]: 1–8. 27 My 1948.

GENERAL BOTANY

(including biography)

Abbe, Ernst C. Frederic King Butters, 1875–1945. Rhodora **50:** 133–144. *port.* 16 Je 1948.

Acosta Solis, M. Tagua or vegetable ivory—a forest product of Ecuador. Econ. Bot. **2:** 46–57. *f. 1–5.* 1948.

Brunel, Jules. Un cas d'empoisonnement grave par des graines de *Datura stramonium* suivi de quelques notes sur la nature du poison et sa localisation dans les graines. Contr. Inst. Bot. Univ. Montréal **62:** 31–37. 1947 [My 1948].

Crooks, D. M. Plants for special uses. Econ. Bot. **2**: 58–72. *f. 1–16.* 1948.

Fosberg, F. Raymond. Economic botany—a modern concept of its scope. Econ. Bot. **2**: 3–14. 1948.

Geiser, S. W. Biographical notes on Dr. Ferdinand Rugel, American botanist. Field & Lab. **16**: 113–119. *port.* Je 1948.

Howe, Sonia. L'élément humain dans les dénominations en géographie et en botanique. Boissiera **7**: 133–154. *2 pl.* 1943.

Llano, George A. Economic uses of lichens. Econ. Bot. **2**: 15–45. *f. 1–15.* 1948.

Yeager, A. F. Plant exploration at home. Proc. Am. Soc. Hort. Sci. **50**: 416–418. D 1947.

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Names of contributors are printed in CAPITALS. Names of new genera, species, varieties, forms, and combinations are printed in **bold face.** Numbers in *italic* refer to pages on which the name is listed as a synonym. Numbers in **bold face** refer to pages on which the name is accompanied by a description or illustration.